Report of the Committee of Visitors
Division of Chemistry
National Science Foundation
February 7-9, 2007

I. Background

The Committee of Visitors (COV) for the Division of Chemistry (CHE) met for three days to review actions taken on proposals handled by the Division during the three year period 2004-2006 and to review the outputs and outcomes of past and current Division investments. The COV comprised of 30 members from the scientific community chosen for their scientific expertise, and awareness of developments in their respective fields of the chemical sciences, as well as a sense of issues, perspective and balance across the chemical sciences. Appendix A is a list of COV members and Appendix B is the meeting agenda. Inclusiveness in the COV membership is illustrated by the committee's geographic, institutional and demographic diversity provided in Appendix A.

The specific issues that the COV was asked to address are:

a) The integrity and efficiency of processes used to solicit, review, recommend and document proposal actions, including such factors as selection of an adequate number of highly qualified reviewers who are free from bias and/or conflict of interest; appropriate use of NSF merit review criteria; documentation related to program officer decisions regarding awards and declines, and the scope, duration and size of projects; balance of awards in terms of subject matter; emerging opportunities; high risk and innovation; size versus number of awards; new investigators; diversity of underrepresented groups; geographic distribution of principal investigators; and overall technical management of the program.

b) Results, in the form of outputs and outcomes of NSF investments for the relevant fiscal years, as they relate to the Foundation's current strategic goals and annual performance goals.

c) The outcome goal for organizational excellence, which includes providing an agile innovative organization that fulfills its mission through leadership in state-of-the-art business practices.

d) The significant impacts and advances that have developed since the previous COV review and are demonstrably linked to NSF investments, regardless of when these investments were made. Examples might include new products or processes, or new fields of research whose creation can be traced to the outputs and outcomes of

NSF-supported projects over an extended period of time.

e) Response of the program(s) under review to recommendations of the previous COV review.

To address (a) the COV members formed into the following seven groups:

Organic and Macromolecular Chemistry (OMC)
Physical Chemistry: Experimental (EPC) and Theoretical and Computational (TCC) Chemistry
Inorganic, Bioinorganic and Organometallic Chemistry (IBO)
Analytical and Surface Chemistry (ASC)
Instrumentation (CRIF)
Centers and Collaboratives (CRC)
Research Experience for Undergraduates (REU) and Education

Prior to the COV meeting, the members of the committee were provided with a number of documents that were posted on the CHE website: (http://www.nsf.gov/events/event_summ.jsp?cntn_id=108234&org=CHE) The documents included the previous COV report covering the years 2001-2003 (held February 3-5, 2004), the Chemistry Division's response to this report updated on an annual basis, the FY 2004, 2005 and 2006 Chemistry Division annual reports, highlights from PIs funded by the division and a variety of other useful information pertinent to the review.

The meeting of the COV began on February 7, 2007 with a review of the charge to the Committee by Tony Chan, Assistant Director, Directorate of Mathematical and Physical Sciences (MPS). Morris Aizenman, Senior Science Associate, MPS, then briefed members on conflict of interest. Luis Echegoyen, Division Director of CHE then gave an overview of the Division, followed by a discussion of the general procedures to be followed by Janice Hicks, Executive Officer of the Division.

For the remaining part of the day, the COV members separated into the seven subpanels. Each subpanel was briefed on the program by a respective Program Director. The COV subpanel members then studied a representative sample of "jackets" containing information on proposals acted on in the previous three years. This review was done electronically by viewing the jackets as "ejackets". The ejackets reviewed included proposals that were deemed obvious for funding, borderline for funding, borderline declined, and obvious declined. In this way, the COV received a quick education in the work of the CHE, including a taste of the difficult decisions

that had to be made. In the late afternoon a First Round A Report was generated by each subgroup that addressed the issues described in (a) above. On the second day, the members of the COV were reformed into seven new subpanels so that each member of the COV was able to review jackets in another area. These new sub-panels prepared a Second Round Report by the end of the Thursday morning session. In the early afternoon a subcommittee of First Round A panel and Second Round A panel merged the two Reports into the Final Merge A Report. The composition of both sets of sub-panels is given in Appendix C, and the Final Merge A Reports are given in Appendix D.

The remainder of the second afternoon was spent discussing the issues described above in (b), (c) and (d) regarding the quality of the results of NSF's investments, referred to as Section B Reports. To facilitate this discussion, COV members assembled into four breakout subgroups formed around the outcome goals of People, Ideas, Tools and Organizational Excellence. Breakout group leaders prepared a Section B report that summarized points from their discussion. Section B groups were then reformed with new members and a second Section B report was prepared by the group leaders. A Section B Merge Report for each of the four topics was prepared at the conclusion of these sessions by the group leaders. The composition of both sets of sub-panels is given in Appendix C, and the Final Merge B Reports are given in Appendix D.

Friday morning began with an hour discussion of the Section B Merge Reports summarized by the chairs of these groups. The remainder of the morning was devoted to an open discussion of general issues including: the response of the Division to the 2004 COV report, whether the division is addressing the NSF strategic goals of funding transformational research and nurturing the scientific workforce and infrastructure, the portfolio balance, the balance of grant size and number of grants, the Division as a leader of the chemistry community and utilization of joint funding opportunities.

After lunch the COV briefed Judith Sunley on the findings and adjourned.

The COV members expressed gratitude to the administrative and technical staff of the Division for their help and hospitality during the meeting, with a particular thanks to Janice Hicks for assembling a large fraction of the helpful documentation needed for the review. The COV members were also appreciative of the candor and helpfulness of the Program Officers, Executive Officer, and Division Director in all their discussions.

II. General Conclusions

The Committee of Visitors concluded that the Chemistry Division is operating very well given the financial constraints and the increasingly high volume of proposals that it handles. The Division plays a leading role in the chemistry community in both research and workforce issues, working with the chemistry community in a very visible and highly effective manner. We have high praise for the quality work of the Program Officers, staff assistants and the Executive Officer Janice Hicks. The Chemistry Division Director has changed hands this past year from Arthur B. Ellis to Luis A. Echegoyen. We are very impressed with the energy and leadership that Director Echegoyen has been bringing to the Division in his first few months as Director and are grateful for the many contributions that Director Ellis made to NSF, CHE and the chemistry community.

In the coming months we urge the Division to develop a Strategic Plan to guide them over the next few years as well as further into the future. As part of this they need to develop large scientific goals and benchmarks to allow measurement of progress. The Strategic Plan must also include goals for assuring that we are recruiting and retaining the best and brightest scientists for this endeavor, and that we are fully utilizing and mentoring those from underrepresented groups. We encourage the leadership to involve PIs in the community in this activity to assist in setting priorities and allocation of resources within the division. The Strategic Plan that results should further strengthen the case for increased funding of chemistry research – a necessary case should be made to MPS given the low level of funding currently being allocated to the CHE division.

We find that the quality of the research funded by the Division is exceptionally high and that the Program Officers are identifying the best science in the proposals that they receive. We are particularly impressed with the single investigator proposals funded and strongly endorse the continued emphasis on single investigator grants. We find the projects in the single investigator category to be of extraordinary quality, as are many of the proposals from numerous new and established investigators that are being declined because of limited funds. Unfortunately the percentage of single investigator proposals funded in the CHE portfolio has been reduced in the past three years from 80% down to 70%. These funds have been shifted to the funding of more grants in the Collaborative Research in Chemistry program (CRCs), which involve small groups of investigators. Such a shift is of concern to a number of COV members given that this has resulted in a

lower percentage of the portfolio going to single investigator programs where the quality and demand is so high.

Although we find that the Division is identifying the best science of the proposals it receives, we have concerns that there is potentially a large fraction of transformational chemistry that is missed because the dwindling grant size deters some PIs from submitting major new projects of a fundamental nature to NSF. Although chemists have several other funding sources for applications-oriented projects, NSF is the only funding agency for most fundamental science in chemistry. As a consequence, the COV believes that a significant fraction of the transformational research that NSF seeks to fund is likely disappearing due to the declining budget capacity.

The Division supports many other types of large and small group grants that are of a collaborative nature. These are important in the portfolio to the extent that they enable and enhance multidisciplinary research areas that greatly benefit from multiple investigators. Given that some of these programs are relatively new, it is a good time to review their efficacy and impact. The Research Experience for Undergraduates Program, one that originated in CHE nearly 20 years ago, continues to be a high impact program but with insufficient funding for the high demand. The instrumentation programs are essential and continue to be of high demand and fund research of high quality.

The Division operates with a high level of integrity and efficiency in processing proposals. It is believed that CHE in general sets a gold standard for quality reviewing of scientific proposals. This has been recognized by other federal agencies as well as international organizations. We are impressed with the high percentage of proposals that are processed within 6 months of receipt (nearing 80%) and commend the Program Officers for this extraordinary effort. The new Director has made it a priority to increase the number of on-site permanent Program Officers, a priority that we endorse. The documentation for the decision process is generally good although we recommend that more information about how the reviews can be used to improve future proposals be given to the PI, particularly in the case of declinations. This may be happening through oral communication with the PI but we did not see adequate documentation of this. As with the previous COV, we recommend that the panel review documentation is in many cases inadequate and needs to be improved.

Overall we are left in a quandary as to why Chemistry has the lowest level of funding in the MPS Directorate. There is only one real solution to

this conflict: the funding available to the Chemistry Division needs to be increased. It is hard to think of any sensible reason for such poor funding for Chemistry within the NSF. Whereas the recent increase in the 2008 budget is appreciated, it does little to overcome the many recent years of low funding levels. The number of active research chemists is quite large, and they contribute to so many areas of national need including U.S. competitiveness in modern manufacturing. Also, chemistry research is not cheap, requiring expensive chemicals and modern instruments. U.S. industry has a large need for trained chemists—companies in which such chemists design and guide the processes comprise over 30% of U.S. industry in terms of value added—so many graduate students in chemistry are needed and produced. Without the obvious solution—to increase the funding of Chemistry within NSF—the conflict between grant size and numbers will continue to be handled as well as possible by the Chemistry Division.

III. Results of the Review

A. Quality of the Processes Related to Program Review

A.1 Use of Merit Review

Most of the proposal reviews in CHE are conducted by individual reviews (ad hoc). Panel reviews are more common for the Integrative Chemical Activities such as instrumentation, centers and collaboratives and education.

Overall COV members found the individual reviews and decisions made on these reviews to be of high quality. Program officers were found to recognize innovative proposals and were more concerned about the overall review content than the actual score. Reassuring evidence was found that the program officers consider, calibrate, and interpret the review comments deeply when making decisions, and are not simply bound by the summary numerical scores of the ad hoc reviewers. This has become increasingly important as the low funding level has required proposals with excellent ratings to be declined. They also appeared to be willing to support high-risk ideas and proposals, though there was significant uncertainty in the defining characteristics of high risk. Program officers appear to interface well with other NSF divisions and agencies, a practice we encourage them to continue. Dwell times were found to be quite good, given the high workload of the program officers, and clustered arrival times of many proposals. While the NSF-wide target of a 6 month or less dwell time for 70% of the proposals

was considered appropriate, the COV challenges CHE to achieve 80% in 6 months. The program officers write a summary and justification for the action taken in the form of a Review Analysis, included in the documentation of each proposal. Review analyses by the program officer were generally well done on individual grants although improvements can be made in communication of more of the content of the analysis to the PIs (either verbal or a redacted written form), particularly in a declination and for newer investigators. This was also recommended in the 2004 COV review. Overall the COV members were very impressed with the Program Officers in evaluating and collating ad hoc reviews, and in producing a fair and equitable decision based on these reviews.

Problems in the review process are more apparent for group and educational grants that are handled by panel review. This was also noted as a problem in the 2004 COV review. Although some panels summarized their findings and decisions well, the majority of the summaries did not provide adequate written justification for their decisions. Panels need more explicit direction and oversight to ensure that the critique and summaries provide sufficient information to the PI for revision. Some reviews from the panels do not address all of the criteria. We recommend that the division develop and implement a strategy for how to improve these written reviews generated by panels so that there is measurable improvement in the next year. In some cases where a panel had been convened after a set of ad hoc reviews, it seemed that the panels simply regurgitated the ad hoc reviews. Members of the COV felt that panels should add value to the review process, and we did not see that effect.

It is an ongoing challenge to get reviewers to provide substantive comments in their reviews that can be of higher value to the decision process. We encourage the division to continue to educate the community on the importance of (1) reviewing proposals and (2) providing substantive and objective comments in their reviews.

A.2 Implementation of the NSF Merit Review Criteria

It was the consensus of the COV members that the reviews are adequately addressing the intellectual merit of the proposals, although further education of foreign reviewers would help. However, the COV found that the broader impact criterion is problematic in many proposals and causes considerable confusion in both the proposals and reviews. CHE has worked hard to educate the community on these two criteria, especially the broader impact criterion. In fact, the program officers were found to very

effectively address both criteria in their analyses. Nevertheless the broader impact is frequently not addressed beyond ancillary comments in proposals. Reviewers often give substantial weighting to the intellectual merit and little value to the broader impact, if they address the broader impact issue at all. The panel summaries do a somewhat better job of reviewing the broader impact criterion but it is often not adequate.

It was clear from our review that many PIs do not understand the broader impact criterion and many reviewers do not know how to evaluate it. What role and weight that broader participation plays in the broader impact criteria also causes a quandary. Further education by CHE and the MPS Directorate is essential to clarify and communicate to the community the broader impact criterion in order for it to be fairly applied.

A.3 Selection of Reviewers

We found that the program officers were working diligently to get the most reviews and best reviewers that they could for the review process. In most cases, an adequate number of reviews were used in a decision. For the ad hoc reviews, the COV members recommend a minimum of 4 reviews, more than four are considered necessary for difficult decisions and three if the first three received reviews indicate a declination is likely. Three are often adequate for panel decisions. Program officers are doing a good job at resolving conflicts of interest but could increase efforts to educate the community about the value of supplying or excluding reviewer names. We commend the program officers for their efforts at recruiting a diverse set of reviewers and encourage them to continue to develop a diverse reviewer base such that under represented groups are used but not over-used in the review process. We recommend that the diversity of the reviewer slate be consistently applied to all proposals, not just those from underrepresented PIs or institutions. We also recommend that they take more advantage of non-academic reviewers, especially when reviewing instrumentation proposals, keeping in mind that for some proposals, some education may be necessary regarding the programs involved.

A. 4 Resulting Portfolio

We found the quality of the supported projects to be very high in all groups. The program officers are clearly identifying the best science that comes their way. NSF should be very proud of the caliber of science funded through CHE.

There are also many exceptionally high quality programs that had to be declined because of inadequate funding – these are heart-wrenching decisions given the high quality of the PIs that are being turned down, the breadth of institutions from which they come, the excellent science that will likely not happen, and the students that will not be able to participate in these many top-flight projects.

There is a serious conflict between the size of the grants and the number of grants that can be awarded. With the funds available the size of many grants is too small to cover the funding of significant projects. Indeed it is often impossible to fund the full support of a single graduate student. The PIs either must cut their efforts much below what is needed - perhaps denying a research and training opportunity to a deserving student - or search for additional funding elsewhere, which is not an easy task.

As with the last COV we recommend that the grant duration of the best proposals in the individual investigator category be extended to four and possibly five years within the constraints of the overall budget of the division. It is important to continue the practice of creativity extensions for the best research. The addition to the portfolio of SGER grants that fund innovative ideas is a good step towards pursuing high-risk science but must be used with caution since it circumvents the peer review process.

With regards to the balance of different types of grants, the current CHE division grant portfolio has individual investigator awards (IIAs), collaboratives (CRCs), centers (CBCs), and REU and Education. Most agree that the highest priority should be to maintain the level of funding for individual investigator awards, as long as these awards are continuing to go to forefront, high impact science. Funding of IIAs and group grant funding should not be at the exclusion of other collaborative and educational activities that are invaluable to the enterprise. Therefore a balance among these types of modes is appropriate, although there is not consensus on the optimum balance. The IIAs have been the traditional funding mode in the CHE division, and have served the division well in terms of generating excellent research as well as training many fantastic new investigators. In addition, this mode provides the basis on which collaboratives may rest, and also gives the individual PI flexibility to follow up new discoveries, and to initiate informal collaborations. Some members of our COV believe that establishment of new centers and collaboratives may be one way to obtain new money and increased visibility for the division---a goal that all definitely support, provided the IIA’s do not suffer further erosion.

Most of the COV members agree that the CRIF:MU program is important and essential, and that the funding level should definitely not be decreased. Also, the CRIF:ID program, although small, is viewed as an important mechanism for obtaining new equipment for established researchers. The CRCs are a mechanism for encouraging collaborative and multidisciplinary research. CBCs, CRCs, and CRIF:CRF-Cyber programs are in their infancy. However, the jury is still out as to whether these are more effective funding modes, in terms of research output per NSF investment, than single investigator grants. Appropriate assessment mechanisms should be put in place to evaluate the effectiveness of each of these new programs. The COV concluded an assessment of these newer programs must happen soon to determine if they should be continued, modified or expanded.

The COV members are enthusiastic about the success and high impact of the REU program in CHE. It is invaluable to the field for engaging, training and inspiring undergraduates (many from underrepresented groups) to pursue higher chemistry degrees. Unfortunately due to budget limitations, many highly qualified sites have recently gone unfunded while new programs such as URCs have been initiated. As with other new programs, it is important to assess the value and effectiveness of the URC program.

As the success rates for new and renewal IIA grants have plummeted, the COV is worried about the loss of many highly regarded single investigator programs and the overall quality of the science in the Division's portfolio. It also diminishes the attractiveness of science for newer PIs that we desperately need to maintain the high level of quality and demographics. We are also worried that this low success rate is causing PIs to drop out of research at an earlier career level. As a consequence, NSF loses its return on its original investment in people while the scientific community loses valuable scientific leaders, and mentors for the training of the next generation of scientists.

It also creates instability in the system and an increased proposal pressure, as more investigators resubmit after a declination. This puts an even greater burden on the program officers. This instability is another indication of the inadequate funding level in the division.

A.5 Program Management

Overall the programs are very well managed. Given the workload of the program officers, and the pressure that they are under, it is a remarkable accomplishment. The chemistry community has always valued the program

officers of CHE. We are encouraged with the plans to add staff, particularly permanent staff to the division. This is especially important for the ASC and ORG programs. With this planned addition of new permanent and on-site staff, it is important to do succession planning so that valuable knowledge and experience of longer-term staff members is not lost.

The staff is also commended for being timely in its response to proposals. With a target of 70% within 6 months, the division ordinarily achieves this in recent years with the exception of Fiscal Year 2006. . Timeliness is particularly important for the REU program where the review process needs to be completed by early December in order for sites to recruit summer students. The increased use of pre-proposals for group competitions is looked at as a good step.

We are pleased to see the addition of science assistants to NSF-CHE. These young chemists are a valuable addition to the division, bringing in new energy while also taking on many important tasks that would otherwise overburden the program officers.

The Division is moving from a single six month submission window to two smaller windows. The hope is that this will coordinate better with cooperative funding ventures with other divisions and also distribute the workload more evenly over time, both for NSF-CHE staff and for the community of reviewers. It is important that the division aggressively work to alert the community of this change and to evaluate its impact on the community and the staff after subsequent years.

B. Division's Performance in Contributing to NSF's Strategic Outcome Goals

B. 1 Quality and Significance of the Science

Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."

Society has pressing needs in health, national security, sustainable energy and the environment. Each of these needs is critically related to the economy. Chemistry is the enabling discipline that permits advances in diverse areas of materials, biology, electronics, catalysis and analytical tools, all of which provide the drivers for solving these societal needs. Collaborations across disciplines, formal or informal, are now commonplace

in order to address major scientific challenges. The CHE portfolio includes a broad range of projects encompassing many new directions. It is impossible to provide in such a short document a full description of the intellectual vigor of the division, and only a few examples will be mentioned below. Specific examples of transformative reactions include "click chemistry," and olefin metathesis (Nobel Prize 2005), which have been incorporated into the syntheses of new electronic materials, and new biological probes. Advances in mass spectrometry have had major impacts in multiple areas including environmental monitoring of pollutants and toxic agents, and gene sequencing and proteomics supporting the emerging field of personalized medicine. The ability to control the synthesis of nanoparticles has broad implications across NSF from physics to materials sciences to biology, and NSF Chemistry supports the fundamental understanding of these processes. Progress in the synthesis of complex molecules supports the discovery and manufacture of pharmaceuticals. In sum, the Chemistry portfolio is enabling fundamental intellectual innovations that catalyze the solution of critical societal issues.

The COV finds that CHE is doing an excellent job of identifying the very best science in its portfolio of applications. However, there is potentially a large fraction of transformational chemistry that is missed because the dwindling grant size deters some PIs from submitting major new projects of a fundamental nature to NSF. Thus, there is a high probability that we are missing the opportunity to support some truly innovative science because the projects can no longer be supported by increasingly inadequate grant size of the typical NSF-CHE award. This concern on the part of PIs also translates to a conservativism on the part of reviewers who are on the whole somewhat less inclined to take risks on creative new ideas compared to the CHE staff. (Note: The CHE staff has been very open to new ideas and keep a close eye out for creativity and innovation.)

It is therefore bewildering to us as to why NSF-CHE is the lowest funded division of MPS. Historically, NSF has funded the core of basic research in chemistry, and more so than most fields, there is a clear payoff to society. For example, we have an unusually large number of entrepreneurs among our academic chemistry colleagues because of this close connection. Our review indicates that an important fraction of very high quality science that has direct relevance to many current societal issues including energy, climate change and sustainability is not being funded by NSF. Consequently, the science is likely being lost since much of this is too fundamental for other agencies. Given the mission-oriented nature of other funding sources,

there is nowhere else to go other than NSF for funding of programs of an innovative fundamental nature.

B.2 Contributions to a Strong and Diverse Workforce
Developing "a diverse, competitive and globally engaged workforce of scientists, engineers, technologists and well-prepared citizens."

While the primary mission of the NSF Chemistry Division is to maintain the country's leadership in science and technology related to the chemical sciences, the greatest portion of the NSF investment goes into training and higher education. The Chemistry division is single handedly responsible for the chemical workforce that supports many aspects of our economy, ranging from higher education, to a wide range of industries, and national defense. There is a great concern that the number of American students interested in the chemical sciences is not sufficiently large to support the needs of the country. While the recruitment of talented foreign students has helped fill the talent void for a number of years, with these students receiving an education and remaining in the country, it is clear that this is no longer the case. In fact, many talented foreign students are now choosing to remain in, or eventually return to their countries, so that they no longer contribute to the highly qualified workforce needed to support our economy. These students are now joining the workforce of competing nations. In this context, we applaud the directions taken by CHE over the last three years. These include a dedicated effort to tap into all sectors of our country's population to produce a competitive workforce. These include outreach efforts that have a strong impact on students and teachers from kindergarten to high school, and a variety of efforts to increase the inclusiveness of women and under represented minorities, such as the COACh workshops, the gender equity workshop, and one being planned for under represented minorities. We feel it will be important for the CHE division to determine how our grants impact the talent pool that we need to be developing. Assessment measures need to be developed to examine the effectiveness of the investment with respect to broader impacts and broadening participation. We feel that the assessment of workforce development by undergraduate research programs is a good model to follow since it shows the value of the program. Assessment would allow for the evaluation of career development of a more diverse student population. We feel that the number of under-represented minorities in Chemistry may be better than other divisions but it is still unacceptably low. Education of the broader population is also an important aspect of the CHE division mission. Efforts include the research experiences for teachers (RET), supplements to

the REU grants, and individual investigators outreach in a wide variety of media. The CHE division has made investments that will better prepare Americans for a global economy. We feel that partnerships with other countries as exemplified by REUs and joint research efforts should be pursued with additional funding. At the same time, efforts to reach citizens in all regions of the country are strongly commended.

We commend CHE for recognizing the importance of broader participation and broader impact in its research endeavors. We note that the societal impact of the Division can be long-term and not all impact can be realized within a typical grant period. The Division's emphasis on broad impact and the myriad ways it can be achieved has had a positive effect on the community by heightening its awareness of these issues. There is, however, significant ambiguity and confusion with regard to the various ways that 'broader impact' can be implemented. The efforts to educate the community on this issue should be continued and even amplified. The next major step may also include amplifying the practice of assessing the success of the broader-impacts aspect of funded work, as appropriate for the specific implementation strategies. The weight given to broader impacts is appropriately variable in most cases. For example, it is appropriately high in the CAREER program. It should be given some attention in every proposal, regardless of the strength of the intellectual merit.

Another aspect of broader impact is the inclusion of women and under-represented minorities as scientists who are funded by CHE. In this context, we note that the success rate within the application pools from women and from URMs is comparable to the rate within the white male group.

B.3 Providing State-of-the-Art Facilities and Tools

Providing "broadly accessible, state-of-the-art S&E facilities, tools and other aspects of an infrastructure that enables discovery, learning and innovation."

CRIF equipment grants to departments e.g. high-field nmrs, mass specs, diffractometers have been essential for the vitality of the community. NSF is to be commended strongly for its extremely important support of chemistry in this arena. Without this program, many U.S. institutions could only provide an education to their graduate students that would be considered primitive by most standards, particularly by the aggressive standards of the international community. These instruments are used in a

communal fashion and are typically utilized both heavily and widely within a given institution. There is simply no other place where chemistry departments can turn to fill this type of need.

We note that the funding allocated for the development of visionary, high-risk instruments seems low, at only $1M. This amount can easily be spent on construction of a single state-of-the-art instrument, and yet this amount is spread over the entire community. It seems therefore that the US is, with only a few exceptions, allowing scientists in other countries to take the lead in developing new, high-risk instrumentation.

The Division of Chemistry has prioritized single-investigator grants over investments in large facilities such as synchrotrons and neutron sources, a strategy that is complementary to the Department of Energy and also to other NSF divisions such as the Division of Materials Research . The decision to remove the matching money requirement, made since the last COV, has been good. There is, however, still some confusion over the matching money 'requirement' and NSF should seek to educate the community. Some examples of positive actions taken by CHE during the previous three years include

1) Support of the Advanced Photon Source (CheMatCARS) State of Art x-ray beam line operation.
2) Support of National High Magnetic Field Laboratory in Florida, especially the ion cyclotron resonance facility
3) Support through II and CRIF-ID of tools and instruments for chemical imaging.
4) Initiation of cyber infrastructure programs (e.g. awards in kinetic data bases)

B.4 Organizational Excellence

The management of the CHE division is very strong. They have responded appropriately and positively to many of the issues in the previous COV report within the budget limitations. In their interactions with the current COV they have been forthcoming and receptive to comments, suggestions and criticisms. CHE has been a leader within NSF pursuing increased diversity among PI's and reviewers, and has sponsored important efforts to increase participation of minorities in science. Focused attention on the broader impacts criterion has helped with this process. The program staff is well trained in modern chemistry, and devoted to its important role at NSF. In terms of the operation of the division, more program officers and

staff are needed in order to do an adequate job of running their programs and mentoring new PIs. In addition, it would be better if a larger fraction of the staff were permanent, rather than rotators, to provide continuity, memory, and established interactions within NSF. A previous program that encouraged incentives leading to interdivisional interactions should be restored. Also, the division may need to rethink the existing subdivision structure, to take formal account of the exciting new areas of chemistry, including those on the physics, materials, and biology interface.

Our largest concern about the present health of the division is its inability to keep funding at an adequate level. Chemistry is the principal science that can contribute to economic strength in the US because of its enormous role in industry, due to its central role in the production, transportation and storage of energy, modern materials, medicinal chemistry, agriculture, environmental remediation and sustainability, and biotechnology. The industries that use chemistry in the production of their product, guided by trained chemists, produce over thirty percent of the value of American manufacturing. In spite of this, NSF support of chemistry is unable to fund a significant amount of outstanding research and education proposals at an adequate level. In part this must be attributed to the inability of the CHE division leadership to make an effective case to the MPS directorate. This is documented in the very significant slippage of CHE funding with respect to other divisions within MPS over the last 8 years. In fact, if the Chemistry division had simply maintained its relative position over these years, its funding would be 25%, or $45M, higher.

We urge the division to develop a Strategic Plan. In this Plan they need to describe large scientific goals that their programs can achieve. The Plan should also involve ways to articulate better the high value of the current research that is being done. Also, we encourage the leadership to canvass the PIs who receive support in the division with regard to priorities and allocation of resources within the division, and also to obtain general constructive feedback. The Strategic Plan that results should further strengthen the case for increased funding of chemistry research – a case that the division needs to make to MPS.

V. Review of Responses of the Division to the 2004 COV Report

CHE was very diligent in the response to previous issues raised by the limited allocation of resources. Comparing the 2004 report to the current one, it is clear that the Chemistry division is in a much worse situation now than it was 3 years ago. In 2004 fewer excellent proposals had to be turned

down, the funding base was not reduced and it was still possible to give a small increase every 3 years to offset inflation. There was also no problem with increased proposal pressure deriving from resubmission by many deserving PI's who had to be declined.

Our assessment of the progress on issues outlined in the CHE response to the 2004 COV is given below:

1) *Increase the number of program officers and perhaps alter the balance of permanent to rotating program officers.* The change in allocation among the types of program officers is actively occurring now. Inclusion of additional science assistants has been beneficial.
2) *Add a second deadline for submission of proposals, increase grant duration and the number of creativity renewals.* There has been a change in deadlines but this was not extensively discussed with the community or the COV. It remains to be seen whether the dual deadlines increase the ability to obtain reviews, and improve the proposal process and dwell time. There has not been evidence of significant increase in grant duration or the number of grants with increased duration. There has been no evidence for increase in the number of creativity extensions. Our hope is that with increased funding that these changes can be implemented as the CHE staff are on board for making these changes.
3) *Use tools like intelligent databases and SciFinder.* Points addressed.
4) *Several issues were raised by the COV that call for enhanced communication with the community.* CHE is applauded for its increased communication with the community. It provides many opportunities for the community to discuss issues at National ACS meetings. It is be exceedingly important to continue and expand these efforts, particularly in the area of broader impacts and program changes.
5) *The COV considered mechanisms for providing feedback to PIs on proposals, such as sending a redacted, written version of the review analyses prepared by Program Officers, and expressed concern over panel summary reviews that were felt to be uneven.* The COV found that that written communication of the review analysis continues to be a problem in many cases. While there may be programmatic requirements, which prohibit delivery of the analysis to the PI, the division needs to come up with a mechanism to communicate information to the PI, which goes further than simple verbal conversations. The panel summaries are still very

uneven in quality. The guidelines, which were supposedly developed in the last three years, have not had an appreciable impact on the quality of the panel summaries.

6) *Removal of the cost-sharing requirement on individual instrumentation.* Removal of cost sharing appears to have had no impact so far. Continued assessment is needed along with continued communication to the community about the impacts of this removal.

7) *Individual investigator awards are a critical component of the CHE portfolio.* The trend of decreasing renewal rates for single investigator grants must be addressed. The percentage of single investigator proposals in the portfolio has been reduced from near 80% to 70% in the past three years. Whereas the COV values group funded activities, chemists have more options for funding opportunities through other agencies and other divisions of NSF for group funding but very few alternatives beyond NSF CHE for fundamental studies conducted by a research group of a single investigator.

8) *SGER grants should be continued and perhaps expanded.* SGERs have increased slowly, consistent with the caution that this COV supports in assuring that these programs be truly exceptional if they are to proceed outside the normal review process.

9) *CAREER applicants would benefit from additional mentoring.* This aspect has been addressed through workshops.

10) *Concern about the increasing disparity between the average size and duration of individual investigator awards from NSF and NIH, potentially driving more PIs away from fundamental chemistry studies and student training.* This comparison between NIH and NSF remains unaddressed.

11) *Diversity is still problematic for chemistry as for many of the sciences. Even though CHE supports underrepresented faculty well, the increasing representation of underrepresented groups at research universities is a particular challenge for the entire community.* The Division's efforts in diversity and in broadening participation are particularly commendable. It is perhaps largely in response to the NSF Chemistry Division that the discipline has become more aware of the issue and more inclusive. The gender equity workshop for department chairs represents one of several good responses from the division. CHE is working diligently to address this issue.

12) *CHE is urged to energize the community to take part in the nascent NSF programs in cyber-technology*. The division has implemented the cyber infrastructure centers program and the results need to be closely assessed.

13) *The new mid-range instrumentation initiative is an opportunity for the chemistry community. NSF CHE should take a lead in organizing workshops and the like to encourage this.* This issue still needs to be addressed. Renewal of midrange instrumentation and infrastructure continues to be a challenge.

14) *NSF CHE should play a leadership role in partnering with NIH and other agencies in areas related to the molecular basis of life processes.* There is not much activity in this area.

15) *CHE needs to play a leadership role in selling chemistry, both to attract the next generation of chemists and to reinforce the fact that an increased investment in basic research in chemistry is in the public interest.* CHE has begun to assemble highlights from programs in the portfolio. Additional pressure needs to be put on PIs to provide these highlights to program officers. The impact of using these highlights on increasing visibility for the division needs to be assessed.

Appendix

Appendix A – COV Members

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Appendix A (cont.) COV Members

The COV comprised 30 members from the scientific community chosen for their scientific expertise, awareness of developments in their respective fields of the chemical sciences, as well as a sense of issues, perspective and balance across the chemical sciences. Inclusiveness in the COV membership is illustrated by the committee's geographic, institutional and demographic diversity, as shown below:

Category	**Number**
Member of MPS Advisory Committee	2
Academic Institutional Type	
Research	18
Comprehensive	4
4-Year	2
Public	17
Private	7
Industry	3
Outside the US	0
Government	3
Location	
Northeast	6
East	2
Southeast	4
Midwest	3
Southwest	4
Rocky Mountain	2
West Coast	9
International	0
Female	13
Male	17
Minority	12
No NSF Support in Five Years	9
Previous Recent COV member	2

The COV was briefed on issues of Conflict of Interest for the purpose of one of the COV's statutory responsibilities, namely the reading of proposals, reviews, and recommendations and commenting on the handling of actions and the appropriateness of recommendations. Each COV member completed a NSF Conflicts of Interest form. In addition, COV members were instructed to reveal to all other COV members in the breakout sessions all such conflicts or appearances of conflicts as described in the NSF Conflicts of Interest Manual 10. Proposals and files were not available to COV members in those cases where the member had a conflict of interest. Furthermore, the COV members were instructed to leave the room during discussion of such actions.

Appendix B – Meeting Agenda

Agenda
Division of Chemistry
Mathematical and Physical Sciences Directorate
2007 Committee of Visitors

Tuesday February 6

7:30 pm Gather at Ballston Place Club Room for refreshments and viewing of the NOVA television special "Forgotten Genius" Documentary about Percy Julian, first black chemist in the National Academy of Sciences 8-10 pm

Wednesday February 7

8:00 am Continental Break (Stafford II Room 555)

8:25 am Welcome
Luis Echegoyen
Division Director, Division of Chemistry

Geraldine Richmond
Professor, University of Oregon
Chair, Division of Chemistry COV

8:30 am Charge to the Committee of Visitors
NSF in Federal Context, Review Criteria, Strategic Plan
Tony F. Chan
Assistant Director, Mathematical and Physical Sciences

8:45 am Conflict of Interest Briefing
Morris Aizenman
Senior Science Associate, Mathematical and Physical Sciences

9:00 am Overview of Division
Luis Echegoyen
Division Director, Division of Chemistry

10:00 am General Procedures, Reviewing a Jacket
Janice Hicks
Executive Officer, Division of Chemistry

Wednesday February 7 (cont.)

10:15 am	Coffee Break (room 555) and Assemble for First Breakout Groups (see assignments for room locations)
10:30 am	Introduction to Program by Program Officers
11:00 am	Begin Program Review (Chairs)
11:45 am	Working Lunch
3:30 pm	Preparation of First Round Report (Chairs) And Afternoon snack
5:00 pm	Adjourn
5:30 pm	Gather in bar area at 1 Gen Thai, 4300 Wilson Blvd (at N. Taylor St). 703-243-9669
6:00 pm	Dinner in today's breakout groups with NSF staff members

Thursday, February 8

7:30 am	Continental Breakfast (Stafford II Room 555)
8:00 am	Assemble for Second Breakout Groups Introduction to Program by Program Officers (see assignments for room locations)
8:30 am	Begin Program Review (Chairs)
11:45 am	Working Lunch
12:15 pm	Preparation of Second Round Report (Chairs)
1:15 pm	Assemble for Merge Breakout Groups Preparation of Merge Reports
2:45 pm	Refreshment Break (Room 555)
3:00 pm	Assemble for Section B Breakout groups (sign up sheets available) (Ideas, room 555; People, room 545; Tools, room 535, Organizational Excellence, room 525)

Thursday, February 8 (cont.)

4:00 pm	Switch to a second Section B Breakout groups (sign up sheets available) (Ideas, room 555; People, room 545; Tools, room 535, Organizational Excellence, room 525)
5:00 pm	Group leaders of Section B Breakout groups meet to merge reports; others adjourn
6:00 pm	Dinner in Ideas, People, Tools, Org Excellence groups Matsutake Restaurant, 4121 Wilson Blvd. (restaurant prefers cash) 703-351-8787
Evening	Section B Breakout Group Leaders, please meet to finalize reports

Friday, February 9

7:30 am	Continental Break (Stafford II Room 555)
8:00 am	Section B Breakout Group Reports (4) and Discussion (room 555)
9:00 am	Open Discussion of Divisional Issues including but not limited to Section C – 5 questions (room 555)
12:00	Working Lunch
2:00 pm	Briefing of Judy Sunley, Executive Officer, Mathematical and Physical Sciences, by COV
3:00 pm	Adjourn

Breakout Group Assignments for COV

Geraldine Richmond, Chair, at large

Program Review -- First Read – Wednesday February 7, 2007; 10:15 am – 5:30 pm

Program	**Analytical and Surface Chemistry (ASC)**	**Inorganic, Bioinorganic and Organo-metallic Chemistry (IBO)**	**Organic and Macro-molecular Chemistry (OMC)**	**Physical: Experimental (EPC) and Theoretical and Computational (TCC)**	Integrative Chemical Activities: **Instrumentation**	Integrative Chemical Activities: **Centers & Collaboratives**	Integrative Chemical Activities: **Education**
Room	**II-545**	**II-535**	**II-555**	**II-525**	**II-517**	**II-595**	**II-e585**
COV ID	C070786	C070814	C070815	C070816	C070817	C070818	C070819
COV Members	Bruce Chase	Daniel Rabinovich	John Brauman	***Hanna Reisler**	Mary Jo Ondrechen	***Joseph Francisco**	Thandi Buthelezi
	Mary Wirth	***Cynthia Burrows**	Peter Vollhardt		***Tony Young**	Mary Boyd	Jim Gentile
	***Pat Thiel**	Kim Dunbar	Carlos Gutierrez	Branka Ladanyi	Miguel Garcia-Garibay	Enrique Peacock-Lopez	***Nancy Jackson**
	Larry Dalton	Lisa McElwee-White	***Ron Breslow**	Greg Hall	Ishita Mukerji	Joseph Jasinski	Tadhg Begley
			Ken Shea	James Skinner			
NSF Program Officers available for consultation (for all sessions)	Kelsey Cook Colby Foss, Zeev Rosenzweig,	Michael Clarke Carol Bessel	Tyrone Mitchell Martin Pomerantz Tingyu Li Ken Doxsee, George Kenyon, Cynthia McClure	Charles Pibel Jeff Krause Joyce Guest	Celeste Rohlfing Wade Sisk	Kathy Covert Raima Larter	Ron Christensen Bob Kuczkowski
Science Assistant, Program Assistant	Renee Wilkerson, Cheryl Edmonds	Jennifer Grasswick, Robert Cruz	Jennifer Grasswick, Robert Cruz	Renee Wilkerson, Cheryl Edmonds	Khaleelah Po Rome, Irma Johnson	Chantel Sabus, Irma Johnson	Chantel Sabus, Irma Johnson

Program Review -- Cross Read – Thursday February 8, 2007; 8:00 am -- 1:15 pm

	Analytical	**Inorganic**	**Organic**	**Physical**	**Instrumentation**	**Centers & Collaboratives**	**Education**
Room	**II-545**	**II-535**	**II-555**	**II-525**	**II-517**	**II-595**	**II-e585**
	***Ishita Mukerji**	Branka Ladanyi	Tony Young	Miguel Garcia-Garibay	Hanna Reisler	Ken Shea	***Peter Vollhardt**
	Joseph Jasinski	Joseph Francisco	Mary Wirth	Mary Boyd	***Daniel Rabinovich**		Mary Jo Ondrechen
	Tadgh Begley	Nancy Jackson	Thandi Buthelezi	Jim Gentile	Bruce Chase	Cynthia Burrows	Kim Dunbar
	John Braumann	Greg Hall	***Larry Dalton**	***Carlos Gutierrez**	James Skinner	***Lisa McElwhee-White**	Pat Thiel
		***Enrique PeacockLopez**				Ron Breslow	

***THOSE IN BOLD SERVE AS CHAIRS OF THE GROUPS**

Program Review -- Merge -- Thursday February 8, 2007; 1:15 pm – 2:45 pm

	Analytical	Inorganic	Organic	Physical	Instrumentation	Centers & Collaboratives	Education
Room	**II-545**	**II-535**	**II-555**	**II-525**	**II-517**	**II-595**	**II-e585**
	***Mary Wirth**	Enrique Peacock-Lopez	John Braumann	Hanna Reisler	***Bruce Chase**		Jim Gentile
	Ishita Mukerji	Greg Hall	Larry Dalton	Carlos Gutierrez	Tony Young	Joseph Francisco	Peter Vollhardt
	Pat Thiel	***Kim Dunbar**	Thandi Buthelezi	***Branka Ladanyi**	Daniel Rabinovich	***Joseph Jasinski**	***Mary Jo Ondrechen**
	Tadgh Begley	Cynthia Burrows	***Ken Shea**	Mary Boyd	Miguel Garcia-Garibay	Lisa McElwee-White	Nancy Jackson
				James Skinner		Ron Breslow	

Section B Breakout – First Group – Thursday February 8, 2007; 3:00 pm – 4:00 pm
(People signed up on Feb. 7, no more than 8 to a room, first come first served)

	Ideas	People	Tools	Organizational Excellence
Room	**II-555**	**II-545**	**II-535**	**II-525**
	Chair-Cynthia Burrows	**Chair - Mary Boyd**	**Chair - Bruce Chase**	**Chair - Ron Breslow**
	Daniel Rabinovitch	Lisa McElwee-White	Nancy Jackson	Larry Dalton
	Mary Wirth	Patricial Thiel	Thandi Buthelezi	Mary Jo Ondrechen
	Greg Hall	Branka Ladanyi	Kenneth Shea	Anthony Young
	Hanna Reisler	Ishita Mukerji		Joseph Jasinski
	James Skinner	Joseph Francisco		Tadhg Begley
	Miguel Garcia-Garibay	James Gentile		Peter Volhardt
	Enrique Peacock-Lopez	Carlos Gutierrez		

Section B Breakout – Second Group – Thursday February 8, 2007; 4:00 pm – 5:00 pm
(People signed up on Feb. 7, no more than 8 to a room, first come first served)

	Ideas	People	Tools	Organizational Excellence
Room	**555**	**545**	**535**	**525**
	Chair - John Brauman	**Chair - Garcia-Garibay**	**Chair -Pat Thiel**	**Chair – James Skinner**
	Lisa McElwee White	Cynthia Burrows	Daniel Rabinovich	Mary Wirth
	Larry Dalton	Bruce Chase	Gregory Hall	Branka Ladanyi
	Mary Jo Ondrechen	Enrique Peacock-Lopez	Joseph Jasinski	Hanna Reisler
	Ishita Mukerji	Thandi Buthelezi		Mary Boyd
	Anthony Young	Tadgh Begley		Joseph Francisco
	Nancy Jackson	Peter Volhardt		Carlos Gutierrez
	James Gentile	Kenneth Shea		
		Ronald Breslow		

Date of COV: Feb. 7, 2007
Program/Cluster/Section: Analytical and Surface Chemistry
Division: CHE
Directorate: MPS
Number of actions reviewed: Awards: 13 Declinations: 10 Other: 0
Total number of actions within Program/Cluster/Division during period under review: Awards: 162 Declinations: 547 Other: 25
Manner in which reviewed actions were selected: Program Director selected 4 obvious awards, 2 obvious declinations, 8 awards in the "decision interval," 4 declinations in the "decision interval;" Computer specialist selected 5 files randomly (1 award and 4 declination recommendations.)

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

A.1 Questions about the quality and effectiveness of the program's use of merit review procedures.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCEDURES	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Is the review mechanism appropriate? (panels, ad hoc reviews, site visits) Comments: **We believe that in general the mechanisms are appropriate. We note that strong grants that received mixed reviews are sent to panels. We think that this is a good mechanism for getting a broad-based review.**	**Yes in general**
2. Is the review process efficient and effective? Comments: **Efficiency is good. We interpret 'effective' to mean reaching the right decision and helping the PIs to direct their future efforts in the case of negative decisions. We feel that in general the system reaches good decisions insofar as is humanly possible, and response #4 addresses an issue regarding the information going back to the PI.**	**Yes**
3. Do the individual reviews (either mail or panel) provide sufficient information for the Principal Investigator(s) to understand the basis for the reviewer's recommendation? Comments: **We answer this question with regard to individual mail reviews only, since we did not see individual panel reviews in the examples. We felt that the mail reviews were informative and deep in most cases. Perhaps the NSF should consider providing guidance to reviewers, to the effect that negative comments should be elaborated substantially.**	**Yes**
4. Do the panel summaries provide sufficient information for the Principal Investigator(s) to understand the basis for the panel recommendation?	**No**

Comments: **Based on the limited number of samples that we saw, the answer is no. They were generally too short and uninformative. They did not provide sufficient information to help the investigator improve the proposal for resubmission. The panel summary should reflect more detail on the discussions and recommendation of the panel.**	
5. Is the documentation for recommendations complete, and does the program officer provide sufficient information and justification (a) for her/his recommendation? (b) for the Principal Investigator(s)? Comments: **The documentation was excellent for most proposals, particularly the review analyses by the Program Officers. It would be good if he Principal Investigator could see the Program Officer's review summary. Review analyses for the CAREER proposals are needed because otherwise the PI's do not receive sufficient information to appropriately modify their grants. For a young person learning to write proposals, this feedback is important.**	**Yes**
6. Is the time to decision (dwell time) appropriate? Comments: **Yes. The improvement in the percentage of grants reviewed in less than 6 mos. is commendable. Statistics on dwell time are excellent!**	**Yes**
7. Additional comments on the quality and effectiveness of the program's use of merit review procedures: **We are very impressed by the Program Officers, who appear to be doing an excellent job of evaluating and collating ad hoc reviews, and producing a fair and equitable decision. An increased response to requests for reviews is needed.**	

A.2 Questions concerning the implementation of the NSF Merit Review Criteria (intellectual merit and broader impacts) by reviewers and program officers.

IMPLEMENTATION OF NSF MERIT REVIEW CRITERIA	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Have the individual reviews (either mail or panel) addressed both merit review criteria? Comments: **Yes, in all the individual mail reviews that we saw, both criteria were addressed. However, it seems that there is large variability among reviewers about the interpretation of 'broader impact,' and the NSF should consider ways of defining this criterion more clearly. For example, one Career proposal was criticized with "The PI describes already-implemented modifications to an upper level instrumental analysis course and plans for modest additional modifications (including the introduction of bioanalytical ms experiments)…." We feel**	**Yes**

that this reviewer was criticizing the PI for doing exactly what is being encouraged by the CAREER program.	
2. Have the panel summaries addressed both merit review criteria? Comments: **Yes, but they sometimes addressed the criteria shallowly.**	**Yes**.
3. Have the *review analyses* (Form 7s) addressed both merit review criteria? Comments: **The review analyses written by the Program Officers have very effectively addressed both criteria.**	**Yes**.
4. Additional comments with respect to implementation of NSF's merit review criteria: **More guidance should be given to reviewers on evaluation of, or definition of, broad impact. It is clear that the relative weighting of the broader impacts criterion varied from case to case.**	

A.3 Questions concerning the selection of reviewers.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Did the program make use of an adequate number of reviewers? Comments: **Given the difficulty in getting reviews, the ASC does an adequate job of getting a reasonable number. It would be ideal to have 5 reviews of every proposal, but a minimum of 4 is adequate, as we realize this is a challenge given the difficulty of obtaining reviews.**	**Yes.**
2. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: **Reviewers should be selected primarily for their calibration with respect to the quality of the science. It is important to have high caliber scientists reviewing proposals.**	**Not always.**
3. Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and underrepresented groups? Comments: **Yes. Information on underrepresented minorities was not made available. With respect to gender, the balance is quite good. We cannot comment on geography.**	**Yes.**
4. Did the program recognize and resolve conflicts of interest when appropriate? Comments: **Yes. We saw two cases of rather subtle conflicts of interest**	**Yes.**

that were appropriately detected and resolved by the Program Officer.	
5. Additional comments on reviewer selection: **We encourage ASC to use more reviewers from industry in cases where the nature of the proposal is appropriate. Scientists at national laboratories can also be used more for this purpose. Members of this group can provide the Program Officers with specific suggestions.**	

A.4 Questions concerning the resulting portfolio of awards under review.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
1. Overall quality of the research and/or education projects supported by the program. **Among the 23 that we analyzed, the proposals that were funded were top-notch. Based on this sampling, we think that the quality of work being supported by NSF is excellent.**	
2. Are awards appropriate in size and duration for the scope of the projects? Comments: **The size of the awards is much too small compared with expectation. It is unrealistic to expect cutting-edge research with extensive collaboration and broad impact at these funding levels. The funding levels for NSF need to go up.** **The award of additional funds for a 4th year in one particularly outstanding case was quite appropriate.**	**NO!**
3. Does the program portfolio have an appropriate balance of: • Innovative/high-risk projects? Comments: **We saw one proposal that was funded, that fell in the high-risk category in our opinion. In general, however, we did not see high-risk proposals. PIs seem to be risk-averse in order to gain funding, and reviewers seem to be risk-averse as well.**	**No.**
4. Does the program portfolio have an appropriate balance of: • Multidisciplinary projects? Comments: **Yes, all funded proposals had cross-disciplinary aspects. Chemistry has evolved, partly as a result of NSF's efforts, into a very outward-looking discipline.**	**Yes**
5. Does the program portfolio have an appropriate balance of: • Funding for centers, groups and awards to individuals? Comments:	NOT APPLICABLE TO INDIVIDUAL CHEMISTRY PROGRAMS
6. Does the program portfolio have an appropriate balance of: • Awards to new investigators? Comments: **The award rate for new investigators is of some concern, especially the drop in non-Career new-PI awards from ca. 15% in 2004-**	**Maybe not.**

2005, to 5% in 2006. We cannot assess whether this is appropriate.	
7. Does the program portfolio have an appropriate balance of: • Geographical distribution of Principal Investigators? Comments:	**Data not available for ASC.**
8. Does the program portfolio have an appropriate balance of: • Institutional types? Comments: **Yes, the graduate-undergraduate institutional balance seems good.**	**Yes.**
9. Does the program portfolio have an appropriate balance of: • Projects that integrate research and education? Comments: **The community seems to be paying a great deal of attention to educational outreach, based on the sampling of proposals we read.**	**Yes.**
10. Does the program portfolio have an appropriate balance: • Across disciplines and subdisciplines of the activity and of emerging opportunities? Comments: **ASC is very well-positioned with regard to nanotechnology and appears to be well-balanced among sub-disciplines.**	**Yes.**
11. Does the program portfolio have appropriate participation of underrepresented groups? Comments: **It is within the shot noise of being acceptable.**	**Yes.**
12. Is the program relevant to national priorities, agency mission, relevant fields and other customer needs? Include citations of relevant external reports. Comments: **ASC funds significant participation in sensors, and detection of dangerous chemicals. This work is strongly in the national interest.**	**Yes.**
13. Additional comments on the quality of the projects or the balance of the portfolio:	

A.5 Management of the program under review.

1. Management of the program. Comments: **Given the constraints of funding and numbers of reviewers, the program officers are doing an excellent job. ASC seems to be a fairly lean operation, which is admirable. We are concerned by the lack of a permanent staff member in ASC, and we regard a permanent Program Officer as a critical need in ASC. However, we have nothing but good things to say about the staff currently in place.**
2. Responsiveness of the program to emerging research and education opportunities. Comments:

We do not have sufficient data to comment.
3. Program planning and prioritization process (internal and external) that guided the development of the portfolio. Comments: **We did not have any direct information about how priorities are set within the program.**
4. Additional comments on program management: **Mechanisms to improve the quality of the reviewer pool and the clarity of the reviews would be valuable.**

Date of COV: February 7-9, 2007
Program/Cluster/Section: Centers and Collaboratives
Division: CHE
Directorate: MPS
Number of actions reviewed: Awards: 3 Declinations: 8 Other: 4
Total number of actions within Program/Cluster/Division during period under review: Awards: 74 Declinations: 350 Other: 275 (preproposals)
Manner in which reviewed actions were selected: Program Director selected 3 CRC declined proposals in the "decision interval," 4 CRC preliminary proposals and 3 CBC proposals; Computer specialist randomly selected 2 CRC awards and 3 CRC declination recommendations.

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

A.1 Questions about the quality and effectiveness of the program's use of merit review procedures.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCEDURES	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Is the review mechanism appropriate? (panels, ad hoc reviews, site visits) Comments: **Use of teleconferencing (for example) for the preproposal panel should be considered to reduce the burden on panelists. Greater expertise could perhaps be brought in with this system.**	Yes
2. Is the review process efficient and effective? Comments: **The effectiveness of the process could be improved by having a minimum of three ad hoc reviewers on the panel to serve as proposal experts.**	Yes
3. Do the individual reviews (either mail or panel) provide sufficient information for the Principal Investigator(s) to understand the basis for the reviewer's recommendation? Comments: **Reviews of preproposals are sometimes terse. Reviews of full proposals were more extensive.**	Yes
4. Do the panel summaries provide sufficient information for the Principal Investigator(s) to understand the basis for the panel recommendation? Comments: **Usually, although a few of the panel summaries drifted to minor considerations such as proposal preparation instead of the scientific issues. The additional review criteria (collaboration in this case) were not well addressed in many cases.**	Yes

5. Is the documentation for recommendations complete, and does the program officer provide sufficient information and justification (a) for her/his recommendation? (b) for the Principal Investigator(s)? Comments: **The requirement for reviewer analysis significantly improved the documentation of the decision. NSF staff should be commended for their careful explanations, especially in the difficult/unusual cases.**	Yes
6. Is the time to decision (dwell time) appropriate? Comments: **The pre-proposal process improved the efficiency of the overall process**	Yes
7. Additional comments on the quality and effectiveness of the program's use of merit review procedures: **The reviewers inconsistently addressed the collaboration criteria for proposals. There was inconsistency among the reviewers in articulating the value and mode of collaboration among groups in the proposal.** **It could be useful to NSF staff to have more databases available during reviewer selection.**	

A.2 Questions concerning the implementation of the NSF Merit Review Criteria (intellectual merit and broader impacts) by reviewers and program officers.

IMPLEMENTATION OF NSF MERIT REVIEW CRITERIA	YES, NO, DATA NOT AVAILABLE, o NOT APPLICABLE
1. Have the individual reviews (either mail or panel) addressed both merit review criteria? Comments: **The intellectual merit criteria are well addressed. The broader impact is frequently not addressed beyond ancillary comments. Reviewers gave substantial weighting to the intellectual merit, and little value to broader impact.**	No
2. Have the panel summaries addressed both merit review criteria? Comments: **The panel summarizes articulated broader impact better the individual reviewers, but still not adequate.**	No
3. Have the *review analyses* (Form 7s) addressed both merit review criteria? Comments: **More approriate consideration was given to broader impact at this level.**	Yes

4. Additional comments with respect to implementation of NSF's merit review criteria: **There is still confusion over what constitutes broader impact at the individual reviewer and panel review stages.** **Very few PI's are addressing broader participation as part of broader impact. Collaborative efforts could provide a valuable opportunity to broaden participation.** **We commend the Chemistry Division for its efforts to broaden participation.**

A.3 Questions concerning the selection of reviewers.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Did the program make use of an adequate number of reviewers? Comments: **An adequate number of requests were made. For some proposals, limited response required decisions to be made with three reviews and a panel summary, when four or more reviews would be preferable.**	No
2. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: **Yes, within the restraints caused by lengthy collaborator/conflict lists for multiple PI proposals.**	Yes
3. Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and underrepresented groups? Comments: **Underrepresented groups and PUI's are not adaquately represented in the reviewer pool at both the individual and panel review stages. For example, one panel has 0 URM on it.**	No
4. Did the program recognize and resolve conflicts of interest when appropriate? Comments:	Yes
5. Additional comments on reviewer selection: **The COV had only 3 representatives from non-doctoral institutions, and a paucity of minority serving institutions.**	

A.4 Questions concerning the resulting portfolio of awards under review.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
1. Overall quality of the research and/or education projects supported by the program. Comments: **The quality of the research projects were excellent.**	Appropriate
2. Are awards appropriate in size and duration for the scope of the projects? Comments: **Duration is fine, award sizes are low.**	Appropriate
3. Does the program portfolio have an appropriate balance of: • Innovative/high-risk projects? Comments: **Innovative, yes. High risk, no**	Unclear see comment
4. Does the program portfolio have an appropriate balance of: • Multidisciplinary projects? Comments: **One of the strengths of the collaborative programs is the strong focus of multidisciplinary research and approaches.**	Appropriate
5. Does the program portfolio have an appropriate balance of: • Funding for centers, groups and awards to individuals? Comments: **The committee questions the distribution of funding between collaborative and individual programs. There seem to be a very small number of collaborative proposals funded. We would like to see more truly collaborative programs funded.**	NOT APPLICABLE TO INDIVIDUAL CHEMISTRY PROGRAMS
6. Does the program portfolio have an appropriate balance of: • Awards to new investigators? Comments: **We did not see new investigators as lead PI's, i.e. heavy scewed toward more senior investigators. They are generally included as co-PIs but most of the collaboratives are led by senior investigators, which seem appropriate given the constraints of the academic tenure system.**	Appropriate
7. Does the program portfolio have an appropriate balance of: • Geographical distribution of Principal Investigators? Comments:	Yes.

8. Does the program portfolio have an appropriate balance of: • Institutional types? Comments: **We would like to see more examples of non-doctoral granting departments and MSI's represented in the collaboratives and centers of the program portfolio.**	
9. Does the program portfolio have an appropriate balance of: • Projects that integrate research and education? Comments:	Yes
10. Does the program portfolio have an appropriate balance: • Across disciplines and subdisciplines of the activity and of emerging opportunities? Comments:	Yes
11. Does the program portfolio have appropriate participation of underrepresented groups? Comments: **From the data provided and statistics this committee saw, the answer is no in spite of continuing efforts by the Chemistry Division to improve participation.**	No
12. Is the program relevant to national priorities, agency mission, relevant fields and other customer needs? Include citations of relevant external reports. Comments: **See NAS report "Beyond the Molecular Frontier."** **We hope that the CRC/CBS will support the environmental science as the EMSI program concludes.**	Yes
13. Additional comments on the quality of the projects or the balance of the portfolio: **We would hope that the balance of the portfolio could in the future be more diverse across institutions, gender, race and ethnicity of PI's and co-PI's. The portfolio of projects is excitingly broad, which is a tribute to the investigators.**	

A.5 Management of the program under review.

1. Management of the program. Comments: **Excellent. Overall management of the program is excellent. However, there has been a significant turn over of program officers, which is a concern.**
2. Responsiveness of the program to emerging research and education opportunities. Comments: **Excellent. The organic evolution of the program has made the program highly responsive to**

emerging research areas as set by the community.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.
Comments:
The science is community driven and NSF provides an appropriate response to national needs. NSF is responsive both to the needs of the community and national needs.

The pre-proposal process has had a positive impact on planning and prioritization. We are surprised at the limited amount of co-funding from within NSF as well as across other government agencies. We hope that the change in submission windows will allow the program officer time to leverage funding across NSF divisions/directorates. We anticipate significant negative impact on the chemistry division as Phase II CBC unfolds unless significant co-funding can be obtained. Co-funding issues will be compounded as the NIRT, EMSI, and other programs will seek renewals.

4. Additional comments on program management:

We suggest that collaborative proposals be considered for renewals only if they have demonstrated: (1) substantial additional impact beyond what individuals could have individually achieved through individual awards, (2) significant weighting on broader impact in particular broader participation of under-represented groups and PUI's, and (3) the development of a cross-institutional organization as evidence by exchange by students and faculty.

NSF is responsive both to the needs of the community and national needs.

Date of COV: Feb. 8, 2007
Program/Cluster/Section: Education
Division: CHE
Directorate: MPS
Number of actions reviewed: Awards: 7 Declinations: 9 Other: 0
Total number of actions within Program/Cluster/Division during period under review: Awards: 137 Declinations: 478 Other: 2
Manner in which reviewed actions were selected: Program Director selected 3 REU proposals, 2 DCF proposals, 2 URC award recommendations, 3 URC declination recommendations. Computer specialist randomly selected 2 REU award recommendations, 2 REU declination recommendations and 2 URC declination recommendations

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

A.1 Questions about the quality and effectiveness of the program's use of merit review procedures.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCEDURES	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Is the review mechanism appropriate? (panels, ad hoc reviews, site visits) Comments: **Panels and site review visits were used appropriately.**	**Yes.**
2. Is the review process efficient and effective? Comments: **The site visits were very helpful in getting information. The decisions regarding awarding grants were pretty clear. We commend the Program Officers for a very efficient process and for accomplishing a large amount of work in a short period of time.**	**Yes.**
3. Do the individual reviews (either mail or panel) provide sufficient information for the Principal Investigator(s) to understand the basis for the reviewer's recommendation? Comments: **The quality of the reviews was uneven, although this may be intrinsic to the nature of the review process. Some of the reviewers—typically those with non-academic backgrounds--did not appreciate the REU program itself and this affected their ability to review the proposal.**	**Yes and no.**
4. Do the panel summaries provide sufficient information for the Principal Investigator(s) to understand the basis for the panel recommendation? Comments:	**No.**

In some cases, the panels did not address the specific review criteria, did not provide criticisms beyond those provided in the individual reviews, and were not constructive. We suggest that the panels be directed to provide substantive input beyond the individual reviews, and to specifically address the review criteria. **Generally good for the URCs. The combination of reviewer reports and panel summaries were usually enough to give PI's information. Since this program requires reviewers with diverse expertise, it might benefit from having a larger group of panel members read each proposal. More stability from year-to-year would be important for URC.**	
5. Is the documentation for recommendations complete, and does the program officer provide sufficient information and justification (a) for her/his recommendation? (b) for the Principal Investigator(s)? Comments: **(a) The documentation generally seems good especially for the URCs, although the NSF Program Officer should add a review analysis at least in those cases where there is no site visit. The site visit reports were very detailed and helpful, hence alleviating the need for a review analysis. (b) In case of rejection, the program should more proactively encourage PIs to contact the Program Officer and the Program Officer should offer constructive advice for resubmission.**	**Yes and no.**
6. Is the time to decision (dwell time) appropriate? Comments: **The Program is doing a good job on fast turn-around. It is highly desirable to reach a decision in six months or less, as the Program normally does, but a longer time is justified in cases where the Program can seek outside money to help reach a positive decision.**	**Yes.**
7. Additional comments on the quality and effectiveness of the program's use of merit review procedures: **Program Officers need to provide thorough documentation for decisions made in the decision-interval range.** **Award announcements for the REU program should be made no later than March 15th of any given year. This will allow both institutions and students to best plan for research opportunities for the following summer.**	

A.2 Questions concerning the implementation of the NSF Merit Review Criteria (intellectual merit and broader impacts) by reviewers and program officers.

IMPLEMENTATION OF NSF MERIT REVIEW CRITERIA	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Have the individual reviews (either mail or panel) addressed both merit review criteria? Comments: **Some reviewers did not address the broader impacts.**	**Yes.**
2. Have the panel summaries addressed both merit review criteria? Comments:	**Yes.**
3. Have the *review analyses* (Form 7s) addressed both merit review criteria? Comments: **Our jackets usually did not have review analyses, except for two of the Discovery Corps jackets. Those two were very good.** **All proposals should receive a review analysis.**	**Data not available (mostly).**
4. Additional comments with respect to implementation of NSF's merit review criteria:	

A.3 Questions concerning the selection of reviewers.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Did the program make use of an adequate number of reviewers? Comments: **In general, 3 reviewers is an acceptable minimum for REUs. However, for the URCs, more than 3 individual reviews should be required. These projects are funded at a very high level, and we felt that 3 individual reviews were simply inadequate in number. The panel summaries indicated that the panelists did not provide additional input, in general, so the decision about whether to proceed to a site review apparently rested on only the 3 reviews.**	**No.**

2. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: **Some of the non-academic reviewers did not appreciate the nature of an REU program, but the reviewers in general were appropriate.**	**Yes in general**
3. Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and underrepresented groups? Comments: **We commend the Program Officers for recruiting such a diverse group of reviewers.**	**Yes**
4. Did the program recognize and resolve conflicts of interest when appropriate? Comments: **We did not see any cases of conflict-of-interest.**	**Data not available**
5. Additional comments on reviewer selection:	

A.4 Questions concerning the resulting portfolio of awards under review.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
1. Overall quality of the research and/or education projects supported by the program. Comments: **The quality of projects, both supported and unsupported, was very high. Unfortunately, many high-quality projects, particularly REUs, were unsupported.**	**Appropriate.**
2. Are awards appropriate in size and duration for the scope of the projects? Comments: **The average size should not fall below a critical mass of 9 students for an REU site.**	**Appropriate.**
3. Does the program portfolio have an appropriate balance of: • Innovative/high-risk projects? Comments: T**he Discovery Corps and URCs are certainly innovative and high-risk.**	**Appropriate.**
4. Does the program portfolio have an appropriate balance of: • Multidisciplinary projects? Comments:	**Appropriate.**

5. Does the program portfolio have an appropriate balance of: • Funding for centers, groups and awards to individuals? Comments:	NOT APPLICABLE TO INDIVIDUAL CHEMISTRY PROGRAMS
6. Does the program portfolio have an appropriate balance of: • Awards to new investigators? Comments: **These programs tend to discriminate against tenure-track, untenured faculty and this is probably appropriate.**	**Not applicable.**
7. Does the program portfolio have an appropriate balance of: • Geographical distribution of Principal Investigators? Comments:	**Appropriate.**
8. Does the program portfolio have an appropriate balance of: • Institutional types? Comments:	**Appropriate.**
9. Does the program portfolio have an appropriate balance of: • Projects that integrate research and education? Comments:	**Appropriate.**
10. Does the program portfolio have an appropriate balance: • Across disciplines and subdisciplines of the activity and of emerging opportunities? Comments: **The programs are too small at this time to have an effective balance across disciplines and sub disciplines.**	**Appropriate.**
11. Does the program portfolio have appropriate participation of underrepresented groups? Comments:	**Appropriate.**
12. Is the program relevant to national priorities, agency mission, relevant fields and other customer needs? Include citations of relevant external reports. Comments: **It certainly addresses the drive to improve national competitiveness in its effort to develop a diverse and educated scientific work force.**	**Appropriate.**
13. Additional comments on the quality of the projects or the balance of the portfolio: **Both the REU and URC programs are outstanding and both are under funded.**	

A.5 Management of the program under review.

1. Management of the program.
Comments:
The Program is managed well, and the excellent efforts by the Program Officers to obtain co-funding should be further encouraged. The Program Officers handle a high workload effectively while under time pressure.

2. Responsiveness of the program to emerging research and education opportunities.
Comments:
The Program has very innovative components and is creating emerging education opportunities.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.
Comments:
The COV did not receive information on prioritization, but we feel that these programs should be a high priority within the Chemistry portfolio. Timing of grant solicitation and award notification should be constructed with the academic calendar in mind.

4. Additional comments on program management:

Use published information to support the effectiveness of undergraduate research as a key mode of increasing numbers of students who pursue careers in science. This should then lead to enhanced funding for this program.

Date of COV: February 7-9, 2007
Program/Cluster/Section: Inorganic, Bioinorganic and Organometallic
Division: CHE
Directorate: MPS
Number of actions reviewed: Awards: 13 Declinations: 10 Other: 0
Total number of actions within Program/Cluster/Division during period under review: Awards: 189 Declinations: 497 Other: 25
Manner in which reviewed actions were selected: Program Director selected 4 obvious awards, 2 obvious declinations, 8 awards in the "decision interval," 4 declinations in the "decision interval;" Computer specialist selected 5 files randomly (1 award and 4 declination recommendations.)

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

A.1 Questions about the quality and effectiveness of the program's use of merit review procedures.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCEDURES	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Is the review mechanism appropriate? (panels, ad hoc reviews, site visits) Comments: **Basically relies on mail reviews for most individual PIs and mail plus panel for CAREER. This method has served the community well.** **The COV members felt that process was clearly and carefully done and commend the PO review analysis.**	Yes
2. Is the review process efficient and effective? Comments: **Generally excellent efficiency, when appropriate levels of staff are available. The reduced staff In 2005 made it difficult to meet the 6-month goal of turnaround.**	Yes
3. Do the individual reviews (either mail or panel) provide sufficient information for the Principal Investigator(s) to understand the basis for the reviewer's recommendation? Comments: **For the most part are the reviews are informative but the committee found a handful of reviews that were extremely short and unhelpful (0554734) and (0449848).**	
4. Do the panel summaries provide sufficient information for the Principal Investigator(s) to understand the basis for the panel recommendation? Comments:	

Because the panel has so much to do in a short period of time, the panel summaries tend to be quite short and not as helpful as the individual reviews. They do generally convey the overall sentiment of the panel, however.	
5. Is the documentation for recommendations complete, and does the program officer provide sufficient information and justification (a) for her/his recommendation? (b) for the Principal Investigator(s)? Comments: **The Review Analyses written by the program officers are very well done and very informative.** **The transmission of this information by telephone conversation with declined investigators may be appropriate. In some cases a written version of the evaluation would be helpful**	a) yes b) not necessarily
6. Is the time to decision (dwell time) appropriate? **Comments: When IBO is properly staffed, they do an excellent job.**	Yes
7. Additional comments on the quality and effectiveness of the program's use of merit review procedures: **Some concern was raised about the selection of reviewers for proposals that underwent multiple reviews…see A3.5.**	

A. 2 Questions concerning the implementation of the NSF Merit Review Criteria (intellectual merit and broader impacts) by reviewers and program officers.

IMPLEMENTATION OF NSF MERIT REVIEW CRITERIA	YES, NO, DATA NOT AVAILABLE, o NOT APPLICABLE
1. Have the individual reviews (either mail or panel) addressed both merit review criteria? Comments: **For the most part all the reviewers comment on both. But the depth of the comments associated with Broader Impact tends to be brief.**	yes
2. Have the panel summaries addressed both merit review criteria? Comments: **The panel summaries have less emphasis on BI than individual reviews.**	yes
3. Have the *review analyses* (Form 7s) addressed both merit review criteria? Comments: **The review analyses show a thorough consideration of both criteria.**	YES

4. Additional comments with respect to implementation of NSF's merit review criteria:

The panel reviews are not providing substantial feedback to the PI. We understand that the program officers take appropriate care to provide detailed feedback to unsuccessful CAREER candidates to supplement the written documentation.

A.3 Questions concerning the selection of reviewers.

SELECTION OF REVIEWERS	**YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE**
1. Did the program make use of an adequate number of reviewers? Comments: **There was always a sufficient number solicited, but sometimes due to poor response, only 3 reviews were obtained. Usually, these were sufficient to make an informed decision, since there were relatively consistent.**	YES
2. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: **In several cases, the reviewers included outliers. We recognize that such individuals can be included for perspective; however, there must be sufficient expertise in the field to provide in-depth review. Internal NSF evaluation of divergent referee reports seems well done.**	YES
3. Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and underrepresented groups? Comments**:** **Much more care was taken to reflect balance when the PI was at an underrepresented institution or if the PI was a member of an underrepresented group. However, for PIs at highly ranked institutions, the reviewer pool was much less diverse.**	
4. Did the program recognize and resolve conflicts of interest when appropriate? Comments:	YES
5. Additional comments on reviewer selection: **It appears to be a policy to honor the PI's request to exclude from the reviewer pool, nearly everyone named by the PI, including, in one case, all those who gave less than an excellent rating to the previous application. This seems a little too accommodating.** **It should be communicated to PI's that providing a comprehensive list of qualified reviewers**	

can be detrimental to their evaluations, since no more than one or two will be selected as referees.
The COV had some concern about the overburdening of a small pool of URM reviewers.

A.4 Questions concerning the resulting portfolio of awards under review.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
1. Overall quality of the research and/or education projects supported by the program. Comments: **The IBO has done a very good job.**	Appropriate
2. Are awards appropriate in size and duration for the scope of the projects? Comments: **Due to budget constraints the amount of funding per proposal is less adequate than it used to be but the alternative of fewer grants is even worse. The grant size is enough to support only one grad student. Duration is adequate.**	Appropriate
3. Does the program portfolio have an appropriate balance of: • Innovative/high-risk projects? Comments:	YES
4. Does the program portfolio have an appropriate balance of: • Multidisciplinary projects? Comments: **Yes it does. It covers some materials and biological sciences**.	
5. Does the program portfolio have an appropriate balance of: • Funding for centers, groups and awards to individuals? Comments:	NOT APPLICABLE TO INDIVIDUAL CHEMISTRY PROGRAMS
6. Does the program portfolio have an appropriate balance of: • Awards to new investigators? Comments: **IBO is doing a very good job.**	Appropriate
7. Does the program portfolio have an appropriate balance of: • Geographical distribution of Principal Investigators? Comments**:** **Appropriate**	Appropriate
8. Does the program portfolio have an appropriate balance of: • Institutional types?	Appropriate

Comments: **This program has been consistent in funding Masters and PUI ; Some members of the panel would like to see more funding to PUI.**	
9. Does the program portfolio have an appropriate balance of: • Projects that integrate research and education? Comments: **The CAREER program makes the portfolio balance.**	Yes
10. Does the program portfolio have an appropriate balance: • Across disciplines and subdisciplines of the activity and of emerging opportunities? Comments:	Yes
11. Does the program portfolio have appropriate participation of underrepresented groups? Comments: **Appropriate but still a challenge**	
12. Is the program relevant to national priorities, agency mission, relevant fields and other customer needs? Include citations of relevant external reports. Comments: **Yes;**	
13. Additional comments on the quality of the projects or the balance of the portfolio: **Awards to PUIs and underrepresented group PIs are sometimes made for proposals with significantly lower scores than others who are declined. Criteria for achieving diversity goals should be clarified.**	

A.5 Management of the program under review.

1. Management of the program. Comments: **Considering the limited staff they have done a very good job managing the program.**
2. Responsiveness of the program to emerging research and education opportunities. Comments: **Good**
3. Program planning and prioritization process (internal and external) that guided the development of the portfolio. Comments: **No comment**
4. Additional comments on program management: **Program officers are effective but overloaded right after the proposal window.**

Date of COV: February 7-9, 2007
Program/Cluster/Section: Instrumentation
Division: Division of Chemistry
Directorate: Mathematical and Physical Science
Number of actions reviewed: Awards: 6 Declinations: 9 Other: 0
Total number of actions within Program/Cluster/Division during period under review: Awards: 218 Declinations: 583 Other: 1
Manner in which reviewed actions were selected: Program Director selected 2 CRIF Multiuser in the "decision interval," 2 CRIF Facilities, 3 CRIF Cyber and 3 CRIF Instrument Development; Computer Specialist randomly selected 5 CRIF Multiuser proposals.

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

A.1 Questions about the quality and effectiveness of the program's use of merit review procedures.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCEDURES	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Is the review mechanism appropriate? (panels, ad hoc reviews, site visits) Comments: **Panel system is very effective for these reviews. It brings in very many areas of expertise and many perspectives. For both CRIF-ID and CRIF-CRF the combination of panel and ad-hoc was good. We recommend the incorporation of ad-hoc reviews into CRIF-MU.**	Yes
2. Is the review process efficient and effective? Comments: **A very high percentage of proposals are reviewed within the 6 month guideline. This process is made somewhat easier by the solicitation mechanism.**	Yes
3. Do the individual reviews (either mail or panel) provide sufficient information for the Principal Investigator(s) to understand the basis for the reviewer's recommendation? Comments: **Some reviews, notable for CRIF-CRF, do not address the all the program criteria. The reviews need to explicitly address all the criteria. Not all of the individual reviews are thorough but generally there are enough to provide sufficient feedback to the PI.**	Yes
4. Do the panel summaries provide sufficient information for the Principal Investigator(s) to understand the basis for the panel recommendation?	

Comments: **Some panel summaries , notable for CRIF-CRF , need to have all the criteria specifically evaluated.** **Discrepancies between individual reviews and the panel summary need to be specifically addressed and reconciled.** **Panels need more explicit direction and oversight to ensure that the critique and summaries provide sufficient information to the PI for revision. Some panel summaries were too vague and not very useful.**	
5. Is the documentation for recommendations complete, and does the program officer provide sufficient information and justification (a) for her/his recommendation? (b) for the Principal Investigator(s)? Comments: **In general, the documentation is clear.** **Programs officers need to be cognizant that sufficient info for proposals in the decision interval are completely documented. PI's of unsuccessful proposals need guidance to improve their proposals for resubmission.** **For a) the review analyses by program officers are very important and should be included to complete the documentation in every jacket (not all did)** **For b) panel summaries are not always sufficient and an attempt to provide the review analysis, perhaps edited would be helpful to the PIs.**	Yes
6. Is the time to decision (dwell time) appropriate? Comments: **Great job by CRIF staff.**	Yes
7. Additional comments on the quality and effectiveness of the program's use of merit review procedures: **Care should be taken to use gender non-specific terms in discussions of reviewers to help protect his/her identity.** **There should be a mechanism by which program officers can indicate that inappropriate or irrelevant comments regarding the program (not the proposal) in the reviews had no bearing on the award decision. (see proposal 0535652.)** **The panels need more explicit direction concerning reconciliation of ad-hoc reviews when they are disparate. They also need to provide sufficient information to the PI in the summary for effective revision of a declined proposal.**	

A.2 Questions concerning the implementation of the NSF Merit Review Criteria (intellectual merit and broader impacts) by reviewers and program officers.

IMPLEMENTATION OF NSF MERIT REVIEW CRITERIA	YES, NO, DATA NOT AVAILABLE, o NOT APPLICABLE
1. Have the individual reviews (either mail or panel) addressed both merit review criteria? Comments: **Chemistry Division has done a good job in communicating the "broader impacts" criterion to the community. The panels have exhibited a good understanding of this criteria. However, individual reviewers should be reminded to address specific criteria to the appropriate solicitations**.	Yes
2. Have the panel summaries addressed both merit review criteria? Comments: **However, individual reviewers should be reminded to address specific criteria to the appropriate solicitations.**	Yes
3. Have the *review analyses* (Form 7s) addressed both merit review criteria? Comments: **Yes, when review analysis were available they were the most useful component of the jacket. Note: there was some confusion about the nomenclature of form 7 versus review analysis.**	Yes
4. Additional comments with respect to implementation of NSF's merit review criteria:	

A.3 Questions concerning the selection of reviewers.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Did the program make use of an adequate number of reviewers? Comments: **We believe that three reviews would be insufficient if the proposal was not subject to discussion by the entire panel. More than three would be beneficial.**	Yes

2. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: **We commend the Program Officers for getting reviews from non-chemistry specialists in evaluating interdisciplinary program proposals, in particular the Cyber program. The division should take pains to communicate to reviewers, esp. those outside of chemistry, what the goals of the Cyber Program are. (Some of the reviewers didn't seem to understand the intent of the program.)** **It was not clear from the composition of the panels and the consistency of the reviews that appropriate expertise was always available.**	Yes
3. Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and underrepresented groups? Comments: **Geographic information was not given for the CRIF reviewers specifically**	Not available
4. Did the program recognize and resolve conflicts of interest when appropriate? Comments:	Yes
5. Additional comments on reviewer selection: **The inclusion of more reviewers from industry and government is strongly encouraged; this will provide additional expertise, broaden the reviewers' pool and alleviate potential conflicts of interest.**	

A.4 Questions concerning the resulting portfolio of awards under review.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
1. Overall quality of the research and/or education projects supported by the program. Comments: **Projects are of high quality. Examples in the CRIF-ID program were especially persuasive.**	Appropriate
2. Are awards appropriate in size and duration for the scope of the projects? Comments:	Appropriate
3. Does the program portfolio have an appropriate balance of: • Innovative/high-risk projects? Comments: **High risk proposals should be encouraged .**	Appropriate

It would be extremely helpful to have a clarification on what defines high risk.	
4. Does the program portfolio have an appropriate balance of: • Multidisciplinary projects? Comments:	Appropriate
5. Does the program portfolio have an appropriate balance of: • Funding for centers, groups and awards to individuals? Comments:	NOT APPLICABLE TO INDIVIDUAL CHEMISTRY PROGRAMS
6. Does the program portfolio have an appropriate balance of: • Awards to new investigators? Comments:	N/A
7. Does the program portfolio have an appropriate balance of: • Geographical distribution of Principal Investigators? Comments:	No data available
8. Does the program portfolio have an appropriate balance of: • Institutional types? Comments: **In FY 06 proposal pressure was 20% for PUI, but the success rate was only 5% in the CRIF/MU program.**	No
9. Does the program portfolio have an appropriate balance of: • Projects that integrate research and education? Comments: **Most of the proposals show strength in this area.**	Yes
10. Does the program portfolio have an appropriate balance: • Across disciplines and subdisciplines of the activity and of emerging opportunities? Comments: **Care needs to be exercised that more types of instrumentation need to be considered and funded.**	Yes
11. Does the program portfolio have appropriate participation of underrepresented groups? Comments: **For CRIF/CRF the results have been very good. We commend the program officer for making advances in this area.** **Insufficient data for CRIF-MU and CRIF-ID.**	
12. Is the program relevant to national priorities, agency mission, relevant fields and other customer needs? Include citations of relevant external	Yes

reports. Comments:	

13. Additional comments on the quality of the projects or the balance of the portfolio:

More resources need to be devoted to instrumentation. Considering that the multi-user impact of most of the proposals is high, the investment in more instrumentation would be a sound one.

We believe that CRIF-MU and CRIF-ID are essential components to the mission of CHE, and the importance of CRIF-CRF-Cyber still needs to be assessed in view of the current budget situation.

A.5 Management of the program under review.

1. Management of the program.
Comments:
Is very good. Program officers have been adapt at solving conflicts

2. Responsiveness of the program to emerging research and education opportunities.
Comments:
Program officers are responding to new opportunities effectively.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.
Comments:
The mechanism for prioritizing funding categories within this program and among other CHE programs is not completely clear (see also A.4.13).

4. Additional comments on program management:

Going to a 5 year cycle (as exemplified by CRIF/CRF) is a positive bold move that should be considered by other parts of the program.

We commend the staff for their excellent performance!

Date of COV: February 7-9, 2007
Program/Cluster/Section: Organic and Macromolecular Chemistry
Division: Chemistry
Directorate: MPS
Number of actions reviewed: Awards: 13 Declinations: 10 Other: 0
Total number of actions within Program/Cluster/Division during period under review: Awards: 280 Declinations: 723 Other: 15
Manner in which reviewed actions were selected: Program Director selected 4 obvious awards, 2 obvious declinations, 8 awards in the "decision interval," 4 declinations in the "decision interval;" Computer specialist selected 5 files randomly (1 award and 4 declination recommendations.)

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

A.1 Questions about the quality and effectiveness of the program's use of merit review procedures.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCEDURES	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Is the review mechanism appropriate? (panels, ad hoc reviews, site visits) Comments: **We saw mostly ad hoc reviews, which had quick turnaround.**	Yes
2. Is the review process efficient and effective? Comments: **The six months target is met with few exceptions.**	Yes
3. Do the individual reviews (either mail or panel) provide sufficient information for the Principal Investigator(s) to understand the basis for the reviewer's recommendation? Comments: In general but there were exceptions. Some reviewers do not explain their ratings sufficiently. Pit in large letters in the solicitation of reviews **WE NEED NOT ONLY YOUR RATING, BUT THE REASONING BEHIND IT. YOUR COMMENTS WILL ALSO BE USED TO EDUCATE THE PROPOSER.**	Yes and No
4. Do the panel summaries provide sufficient information for the Principal Investigator(s) to understand the basis for the panel recommendation? Comments: **The level of information provided was typically unacceptably low. This**	no

deficiency should be addressed by emphasis to panels on the need to prepare meaningful summaries. **We had only one panel summary**	
5. Is the documentation for recommendations complete, and does the program officer provide sufficient information and justification (a) for her/his recommendation? (b) for the Principal Investigator(s)? Comments: **(a) yes, very thoughtful and thorough. All factors were considered.(b) the justification is not sent, but is sometimes communicated verbally on enquiry. Communicating the review summary would be helpful to PI's.**	(a) yes (b) not normally sent
6. Is the time to decision (dwell time) appropriate? Comments: **It is within the target of 6 months, which is reasonable and shorter than for many other funding agencies.**	Yes
7. Additional comments on the quality and effectiveness of the program's use of merit review procedures: **SciFinder Scholar is really needed to help the review process. [see also the 2004 review] Additional guidance from the panel to program officers in ranking ordering of proposals would be useful together with a clarification of intellectual merit and broader impact reasons for this ordering. In like manner, program officers should be encouraged (in a few cases) to take a more critical view of remarks by ad hoc reviewers to make sure that the comments reflect scientific validity and not opinion and that a balance is achieved with respect to both review criteria.**	

A.2 Questions concerning the implementation of the NSF Merit Review Criteria (intellectual merit and broader impacts) by reviewers and program officers.

IMPLEMENTATION OF NSF MERIT REVIEW CRITERIA	**YES, NO, DATA NOT AVAILABLE, o NOT APPLICABLE**
1. Have the individual reviews (either mail or panel) addressed both merit review criteria? Comments: **This requirement is taken seriously. Foreign reviewers often did not understand this requirement.** **More explicit instructions with respect to evaluating broader impacts would be helpful. There is some concern that some investigators were penalized for on-going broader impact activities versus new/innovative activities.** **Possible problems of balancing the importance of broader impact were helped by the program director**	mostly

2. Have the panel summaries addressed both merit review criteria? Comments: **Only one panel seen**	Not applicable
3. Have the *review analyses* (Form 7s) addressed both merit review criteria? Comments: **Very well done.**	Yes
4. Additional comments with respect to implementation of NSF's merit review criteria: **The new guidelines are helpful.**	

A.3 Questions concerning the selection of reviewers.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Did the program make use of an adequate number of reviewers? Comments: **Mainly, and a sensible number were invited.**	Yes
2. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: **Not completely. Most reviewers need to be experts, to evaluate the novelty and impact of the proposals.**	Mainly
3. Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and underrepresented groups? Comments: **It seems to be the appropriate level.** **Generally yes from what we have seen in our selected examples but in general the data is not available.**	Yes
4. Did the program recognize and resolve conflicts of interest when appropriate? Comments: **Miraculously, none were found.**	Yes.
5. Additional comments on reviewer selection: **The NSF staff need access to SciFinder to help in the reviewer selection.**	

A.4 Questions concerning the resulting portfolio of awards under review.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
1. Overall quality of the research and/or education projects supported by the program. Comments: **A program of which NSF should be proud.**	Appropriate
2. Are awards appropriate in size and duration for the scope of the projects? Comments: **They are quite inadequate, considering the positive role of chemistry in the economic future and competitiveness of the U.S. The low budget of the Chemistry Division within NSF is completely unjustified.**	No
3. Does the program portfolio have an appropriate balance of: • Innovative/high-risk projects? Comments: **They make a specific effort to fund an appropriate number of high risk proposals.**	Yes
4. Does the program portfolio have an appropriate balance of: • Multidisciplinary projects? Comments:	Not considered
5. Does the program portfolio have an appropriate balance of: • Funding for centers, groups and awards to individuals? Comments:	NOT APPLICABLE TO INDIVIDUAL CHEMISTRY PROGRAMS
6. Does the program portfolio have an appropriate balance of: • Awards to new investigators? Comments: **There is an active effort to fund new investigators.**	Yes
7. Does the program portfolio have an appropriate balance of: • Geographical distribution of Principal Investigators? Comments: **EPSCOR helps with this.**	Yes
8. Does the program portfolio have an appropriate balance of: • Institutional types? Comments: **Both undergraduate and Ph.D.-granting institutions are supported.**	Yes

9. Does the program portfolio have an appropriate balance of: • Projects that integrate research and education? Comments: **University and undergraduate research is principally done by students as part of their education and training.**	Yes
10. Does the program portfolio have an appropriate balance: • Across disciplines and subdisciplines of the activity and of emerging opportunities? Comments: **But some subdisciplines are carrying 150-year old names, and additional naming is needed to make it clear how large and novel the range of subjects is.**	Yes
11. Does the program portfolio have appropriate participation of underrepresented groups? Comment **The success rates for minorities and women are at least as high as those for white males, but the numbers are too small—a national problem that the Chemistry Division is addressing.** **The success rate percentage is appropriate but the total numbers are too low. Improvement will not be easy (for many reasons) but improvement is needed. Perhaps, the longer term solution to this problem can be advanced by In general the quality of the projects are very high and the balance of the portfolio is entirely appropriate placing more emphasis in Broader Impacts on diversity improvement.**	No
12. Is the program relevant to national priorities, agency mission, relevant fields and other customer needs? Include citations of relevant external reports. Comments: **Many reports, including the NAS report "Beyond the Molecular Frontier", have described goals that the Chemistry Division is vigorously pursuing.** **This program could play an important role in the implementation of the American Competitiveness Initiative.**	Yes
13. Additional comments on the quality of the projects or the balance of the portfolio: **It is a great—but underfunded—program.**	

A.5 Management of the program under review.

1. Management of the program. Comments: **They do a great job, but are understaffed and need additional salary lines, including those for permanent people.** **Overall, the program is well managed. In one or two cases, the review analysis of the**

program manager parroted the comments of the ad hoc reviewers where a more critical analysis of the reviewers' comments would have been appropriate.* In general, the judgment and technical expertise of program managers is better than that of the peer review community. Perhaps, reviewer training should be implemented but encouraging program managers to take a greater role in critical analysis of reviews would seem to be an appropriate avenue to improvement of the peer review process.

***This problem was a deciding factor for a female PI (proposal #0613057), where criticisms of one reviewer were taken at face value. Specifically, two suggested improvements were interpreted as fatal flaws. Also, there was no female reviewer.**

2. Responsiveness of the program to emerging research and education opportunities.
Comments:
The staff really keep up, and are intellectually active scientists.

The rotators bring in special contact with new ideas and scientific trends. They nearly always maintain their own research programs in their home institutions at the same time, while continuing to publish in scientific journals..

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.
Comments:
The Chemistry Division program staff believes strongly in the creative imagination of members of the scientific community, and rarely indulges in top down management of scientific ideas. However, it does stimulate the imagination of individual chemists by running workshops and encouraging proposals in some special areas of national concern.
Yes, the program planning ad prioritization process has effectively guided the development of the portfolio and has been in tune with budget realities and demands for enhanced societal impact.

4. Additional comments on program management:

Date of COV: February 8, 2007
Program/Cluster/Section: Physical Chemistry
Division: CHE
Directorate: MPS
Number of actions reviewed: Awards: 14 Declinations: 10 Other: 0
Total number of actions within Program/Cluster/Division during period under review: Awards: 252 Declinations: 478 Other: 21
Manner in which reviewed actions were selected: Program Director selected 4 obvious awards, 2 obvious declinations, 8 awards in the "decision interval," 4 declinations in the "decision interval;" Computer specialist selected 5 files randomly (1 award and 4 declination recommendations.)

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

A.1 Questions about the quality and effectiveness of the program's use of merit review procedures.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCEDURES	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Is the review mechanism appropriate? (panels, ad hoc reviews, site visits) Comments: **The majority of reviews were done ad hoc, with strong input by program officers. This ability to select from among a very large reviewer pool the most appropriate ones to evaluate a given proposal is viewed as a strength. Panels for special programs such as CAREER is viewed as most appropriate, with care taken that the summaries include the ad hoc and panel concerns.**	YES
2. Is the review process efficient and effective? Comments: **PHY has been able to establish a very reasonable dwell time, particularly with the considerable increase in the proposal pressure. Program staff is already overtaxed, and it is likely that effectiveness cannot be maintained without additional staff support.**	YES
3. Do the individual reviews (either mail or panel) provide sufficient information for the Principal Investigator(s) to understand the basis for the reviewer's recommendation? **Comments:** **For the most part there is sufficient information in the ad hoc for PIs to understand the reasons for decisions. However where there is a mismatch between reviewer comments and reviewer rating, this becomes**	YES

problematic. **Individual panel reviews frequently do not address both merit cariteria.**	
4. Do the panel summaries provide sufficient information for the Principal Investigator(s) to understand the basis for the panel recommendation? **Comments:** **Panel summaries are uneven, with some quite useful, and others so brief as to be not useful.**	Yes
5. Is the documentation for recommendations complete, and does the program officer provide sufficient information and justification (a) for her/his recommendation? (b) for the Principal Investigator(s)? Comments: **Generally this is the case. There were some concerns with some purely internal decisions such as SGER and creativity extensions, where documentation was not always evident. This may be a consequence of the transition to an all electronic format.**	YES
6. Is the time to decision (dwell time) appropriate? Comments: **The PHYS is to be commended on the very good dwell times, particularly with the increased proposal pressure. Their work has been extraordinary.**	
7. Additional comments on the quality and effectiveness of the program's use of merit review procedures: **The care PHY takes in selecting appropriate reviewers for PUI proposals is a commendable.** **The high quality of the review process may be unsustainable with the present staffing. The increase in proposal pressure dictates that additional staff be hired.**	

A.2 Questions concerning the implementation of the NSF Merit Review Criteria (intellectual merit and broader impacts) by reviewers and program officers.

IMPLEMENTATION OF NSF MERIT REVIEW CRITERIA	YES, NO, DATA NOT AVAILABLE, o NOT APPLICABLE
1. Have the individual reviews (either mail or panel) addressed both merit review criteria? Comments: **The intellectual merit is clearly addressed, but the broader impacts**	NO

criterion is very unevenly dealt with, even in funded proposals. This is the case even in CAREER proposals.	
2. Have the panel summaries addressed both merit review criteria? Comments: **Panel summaries do address both criteria.**	YES
3. Have the *review analyses* (Form 7s) addressed both merit review criteria? Comments: **The review analyses have been excellent, and overall the most useful documents in the review process.**	YES
4. Additional comments with respect to implementation of NSF's merit review criteria: **There continues to be confusion among applicants and reviewers about the broader impacts criterion. The broader participation by underrepresented groups is not considered by many if not most of the applications, nor explicitly considered by reviewers.**	

A.3 Questions concerning the selection of reviewers.

SELECTION OF REVIEWERS	**YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE**
1. Did the program make use of an adequate number of reviewers? Comments: **Program was very diligent about requesting a reasonable number of reviews (generally seven), and apparently did not make decisions with fewer than three.**	YES
2. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: **This is a strength of the ad hoc review process where a very appropriate review group can be established for any given application.**	YES
3. Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and underrepresented groups? Comments: **Considerable sensitivity was evident in dealing with the above criteria. However the low participation by minority group members continues to be of concern.**	YES
4. Did the program recognize and resolve conflicts of interest when appropriate?	

Comments: **Program is very sensitive to dealing with conflicts of interest, and dealt with them directly and without controversy.**	
5. Additional comments on reviewer selection:	

A.4 Questions concerning the resulting portfolio of awards under review.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
1. Overall quality of the research and/or education projects supported by the program. Comments:	APPROPRIATE
2. Are awards appropriate in size and duration for the scope of the projects? Comments: **The award $$ amount is too low, and the NSF is encouraged to secure more funding to increase award size without decreasing the number of awards.** **The award duration should be increased to four years, particularly for awards with good broader impacts criteria.**	APPROPRIATE
3. Does the program portfolio have an appropriate balance of: • Innovative/high-risk projects? Comments:	APPROPRIATE
4. Does the program portfolio have an appropriate balance of: • Multidisciplinary projects? Comments:	APPROPRIATE
5. Does the program portfolio have an appropriate balance of: • Funding for centers, groups and awards to individuals? Comments:	NOT APPLICABLE TO INDIVIDUAL CHEMISTRY PROGRAMS
6. Does the program portfolio have an appropriate balance of: • Awards to new investigators? Comments: **Needs constant attention for inclusiveness. Young investigators need to be mentored in preparing good applications.**	APPROPRIATE
7. Does the program portfolio have an appropriate balance of: • Geographical distribution of Principal Investigators? Comments:	APPROPRIATE

8. Does the program portfolio have an appropriate balance of: • Institutional types? Comments:	APPROPRIATE
9. Does the program portfolio have an appropriate balance of: • Projects that integrate research and education? Comments: **There was generally little attention given to education, even in CAREER awards.**	INAPPROPRIATE
10. Does the program portfolio have an appropriate balance: • Across disciplines and subdisciplines of the activity and of emerging opportunities? Comments:	APPROPRIATE
11. Does the program portfolio have appropriate participation of underrepresented groups? Comments: **There are too few women and minority PIs who are submitting applications.**	INAPPROPRIATE
12. Is the program relevant to national priorities, agency mission, relevant fields and other customer needs? Include citations of relevant external reports. Comments: **The greater participation by a diverse workforce still needs attention. Cf The Gathering Storm**	APPROPRIATE
13. Additional comments on the quality of the projects or the balance of the portfolio:	

A.5 Management of the program under review.

1. Management of the program. Comments: **Outstanding. These individuals do a great job for the division, even in the areas of concern.**
2. Responsiveness of the program to emerging research and education opportunities. Comments: **Yes to research, and no to education.**
3. Program planning and prioritization process (internal and external) that guided the development of the portfolio. Comments: **The portfolio developed based on proposal pressure and quality.**
4. Additional comments on program management:

CHE should develop clearer criteria and educate the community regarding broader impacts. CHE also need to develop methods of assessment for reviews and renewals.

B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes as appropriate. Examples should reference the NSF award number, the Principal Investigator(s) names, and their institutions.

B.1 OUTCOME GOAL for PEOPLE: Developing "a diverse, competitive and globally engaged workforce of scientists, engineers, technologists and well-prepared citizens."

Comments:
While the primary mission of the NSF Chemistry Division is to maintain the country's leadership in science and technology, the greatest portion of the NSF investment goes into training and higher education. The Chemistry division is single handedly responsible for the workforce that supports many aspects of our economy, ranging from higher education, a wide range of industries, and National defense. Given that, there is a great concern that the number of American students interested in the chemical sciences is not sufficiently large to support the needs of the country. While the recruitment of talented foreign students has helped fill the talent void for a number of years, receiving an education and remaining in the country, it is clear that this is not longer the case. In fact, many talented foreign students are now choosing to remain in, or eventually return to their countries, so that they no longer contribute to the highly qualified workforce needed to support our economy. In fact, these students are now joining the workforce of competing nations. In this context, we applaud the directions taken by the chemistry division over the last three years. These include a strongly dedicated effort to tap into all sectors of our country's population to produce a competitive workforce. These include outreach efforts that have a strong impact on students and teachers from kindergarten to high school, and a variety of efforts to increase the inclusiveness of women and under represented minorities, such as the COACh workshops, the gender equity workshop, and one in the planning for under represented minorities. We feel it will be important for the CHE division to determine how the talent pool that we need to be developing is impacted by our grants. Assessment measures need to be developed to examine the effectiveness of the investment with respect to broader impacts and broadening participation. We feel that the assessment of workforce development by undergraduate research opportunities programs is a good model to follow since it shows the value of the program. Assessment would allow for the evaluation of career development of a more diverse student population. We feel that the number and under represented minorities in Chemistry may be better than other divisions but it is still unacceptably low. Education of the broader population is also an important of the CHE division mission. Efforts include the research experiences for teachers (RET), supplements to the REU grants, and individual investigators outreach in a wider variety of media. The CHE division has made investments that will better prepare Americans for a global economy. We feel that partnerships with other countries as exemplified by REU's and joint research efforts should be aggressively pursued. At the same time, efforts to reach citizens in all region of the country are strongly commended.

The NSF CHE has one of the best records in the foundation in terms of the REU program.

B.2 OUTCOME GOAL for IDEAS: Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."

Comments: Society has pressing needs in health, national security, sustainable energy and the environment, and each of these needs is critically related to the economy. Chemistry is the enabling discipline that permits advances in diverse areas of materials, biology, electronics, catalysis and

analytical tools, all of which provide the drivers for solving these societal needs. Collaborations across disciplines, formal or informal, are now commonplace in order to address major scientific challenges. The Chemistry Division portfolio includes a broad range of projects encompassing many new directions. Specific examples of transformative reactions include "click chemistry," and olefin metathesis (Nobel Prize 2005) which have been incorporated into the syntheses of new electronic materials and new biological probes. Advances in mass spectrometry have had major impacts in multiple areas including environmental monitoring of pollutants and toxic agents, and gene sequencing and proteomics supporting the emerging field of personalized medicine. The ability to control the synthesis of nanoparticles has broad implications across NSF from physics to materials sciences to biology, and the fundamental understanding of these processes is supported by NSF Chemistry. Progress in the synthesis of complex molecules supports the discovery and manufacture of pharmaceuticals. In sum, the Chemistry portfolio is enabling fundamental intellectual innovations that catalyze the solution of critical societal issues.

B.3 <u>OUTCOME GOAL for TOOLS:</u> Providing "broadly accessible, state-of-the-art S&E facilities, tools and other infrastructure that enable discovery, learning and innovation."

Comments:
CRIF equipment grants to departments e.g. high-field nmr's, mass specs, diffractometers have been essential for the vitality of the community.
Generally, chemists have been very effective at leveraging other sources of funding for instrumentation.
Funding allocated for visionary, high-risk instruments seems low.
The Division of Chemistry has prioritized single-investigator grants over investments in large facilities, a strategy that is complementary to DOE's.
The decision to remove the matching money requirement, made since the last COV, has been good. There is, however, still some confusion over the matching money 'requirement' and NSF should seek to educate the community.
Some examples of positive actions taken by CHE during the previous three years include

5) Support of APS (CheMatCARS) State of Art x-ray beam line operation.
6) Support of NHFML (Florida) *especially the ion cyclotron resonance facility*
7) Support through II and CRIF-ID of tools and instruments for chemical imaging.
8) Initiation of cyber infrastructure programs (e.g. awards in kinetic data bases)

B.4 <u>OUTCOME GOAL for ORGANIZATIONAL EXCELLENCE</u>: Providing "an agile, innovative organization that fulfills its mission through leadership in state-of-the-art business practices."

Comments:
The management of the CHE div is very strong. They have responded appropriately and positively to the previous COV report. In their interactions with the current COV they have been forthcoming and receptive to comments, suggestions and criticisms. CHE has been a leader within NSF in pursuing increased diversity among PIs and reviewers, and have sponsored important programs to increase participation of minorities in science. Focused attention on the Broader Impacts criterion has helped with this process. The program staff are well-trained in modern chemistry, and devoted to their important role at NSF. Thus in these repects they have much to be proud of.

Our largest concern about the present health of the division is its inability to keep funding at an adequate level. Chemistry is perhaps the principal science that can contribute to the economic strength in the US, because of its enormous role in industry, due to its central role in the production, transportation and storage of energy, modern materials, medicinal chemistry, agriculture,

environmental remediation and sustainability, and biotechnology. The industries that use chemistry in the production of their products, guided by trained chemists, produce over thirty percent of the value of American manufacturing. In spite of this, NSF support of chemistry is unable to fund a significant amount of outstanding research and education proposals at an adequate level. In part this must be attributed to the inability of the CHE division leadership to make an effective case to the MPS directorate. This is documented in the very significant slippage of CHE funding with respect to other divisions within MPS over the last 8 years. In fact, if the Chemistry division had simply maintained its relative position over these years, its funding would be 25%, or $45M, higher.

In terms of the organization of the division, it seems clear that we need more program officers and staff, in order to do an adequate job of running their programs, and mentoring new PIs. In addition, it would be better if a larger fraction of the staff were permanent, rather than rotators, to provide continuity, memory, and established interactions within NSF. A previous program that encouraged incentives leading to interdivisional

PART C. OTHER TOPICS CONSIDERING THE DIVISION OF CHEMISTRY AS A WHOLE

Responses to these questions are given in the narrative of this document.

Question 1. CHE response to previous COV recommendations

Question 2A. How is the NSF Division of Chemistry addressing the NSF strategic goal of funding transformational research?

Question 2B. How is NSF/CHE addressing the NSF strategic goal of nurturing the scientific workforce and infrastructure?

Question 3. Given these multiple goals of the NSF, is the current CHE award portfolio balance among individual investigator awards (IIAs), collaboratives, instrumentation, education, and centers appropriate and if not, what shifts are needed? What are the benefits to the community to the different types of awards?

Question 4. Please comment on the size of the Division of Chemistry grants, and the decisions that are being made with respect to the trade-off between grant size and number of grants.

Question 5. Is the NSF Division of Chemistry effectively leading the chemistry community? Some mechanisms include programs, topical workshops, supporting studies such as the National Research Council studies, and other special projects.

Question 6. NSF Chemistry is increasingly using joint review with other funding agencies (federal and international). Are we doing a good job with these joint reviews? What concerns might the community have about this kind of joint review?